Doctoring 3 Didactic Session
Skills Workshop
August 6, 2025

Chest Imaging

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AI Interlude
Radiographic Anatomy
Lines & Tubes
Recognizing Pathology
Unknown Cases

Chest Imaging

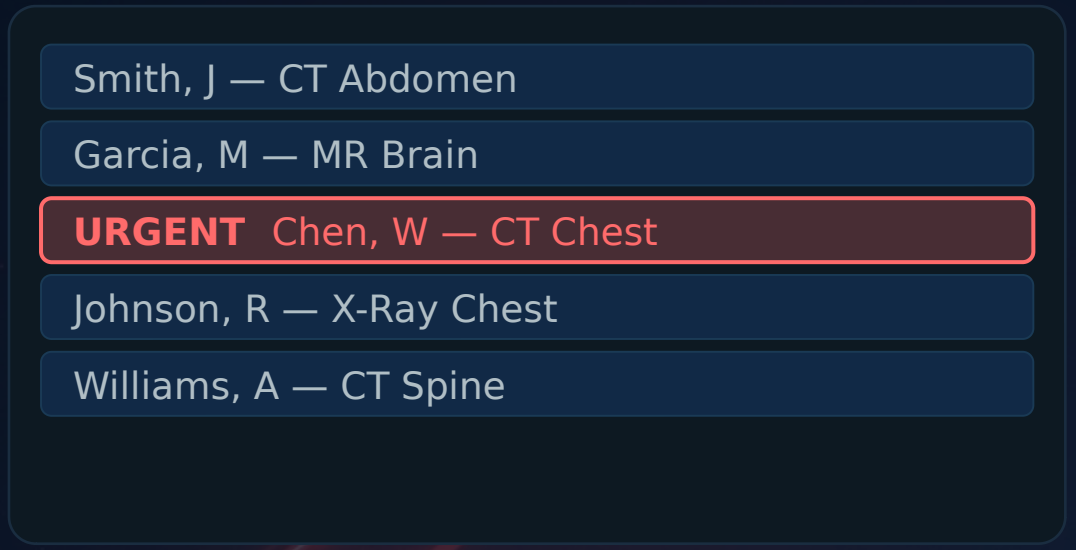
AI Is Here

AI Is Here

1,000+

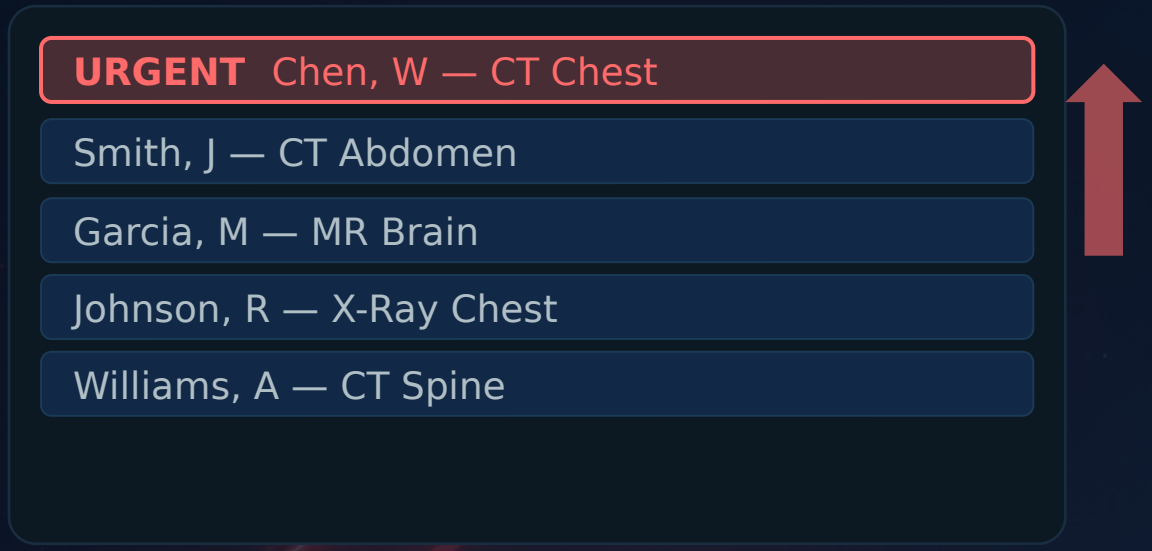
FDA-cleared AI devices in radiology alone. ~75% of all medical AI authorizations.

Triage AI — Jumping the Queue



AI scans every image for critical findings — intracranial hemorrhage, pulmonary embolism, fractures — and flags them instantly.

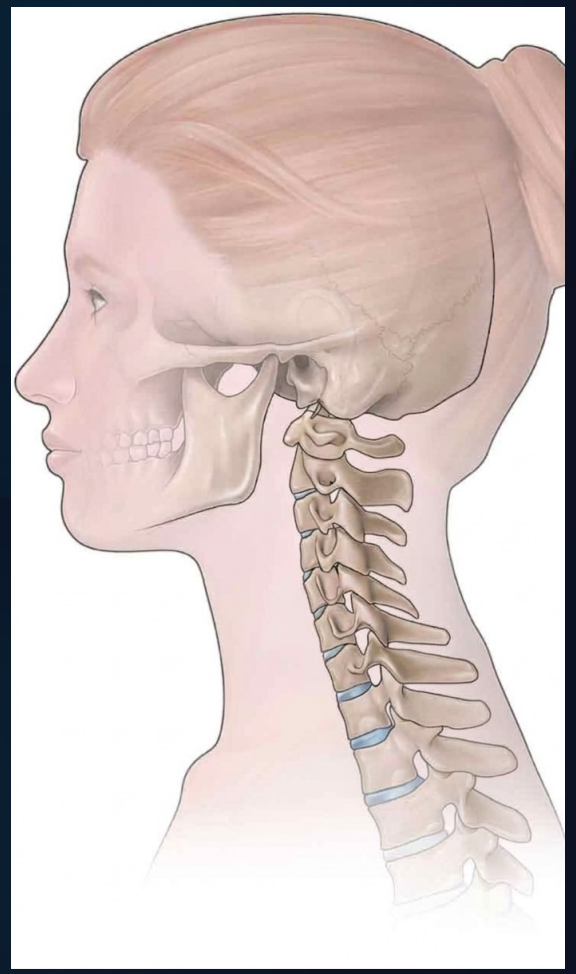
Triage AI — Jumping the Queue

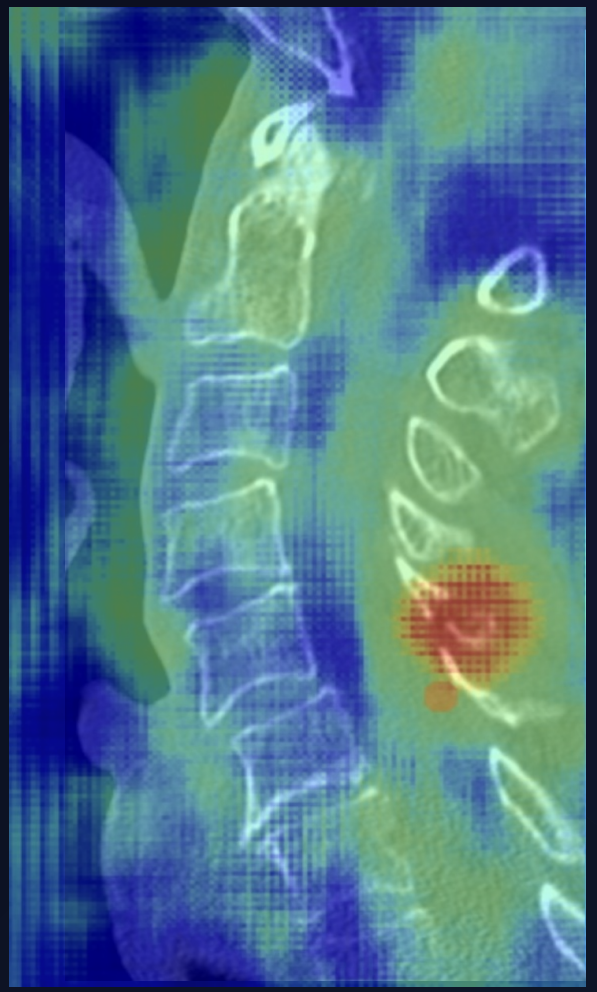


AI scans every image for critical findings — intracranial hemorrhage, pulmonary embolism, fractures — and flags them instantly.

Critical cases jump to the front of the line.

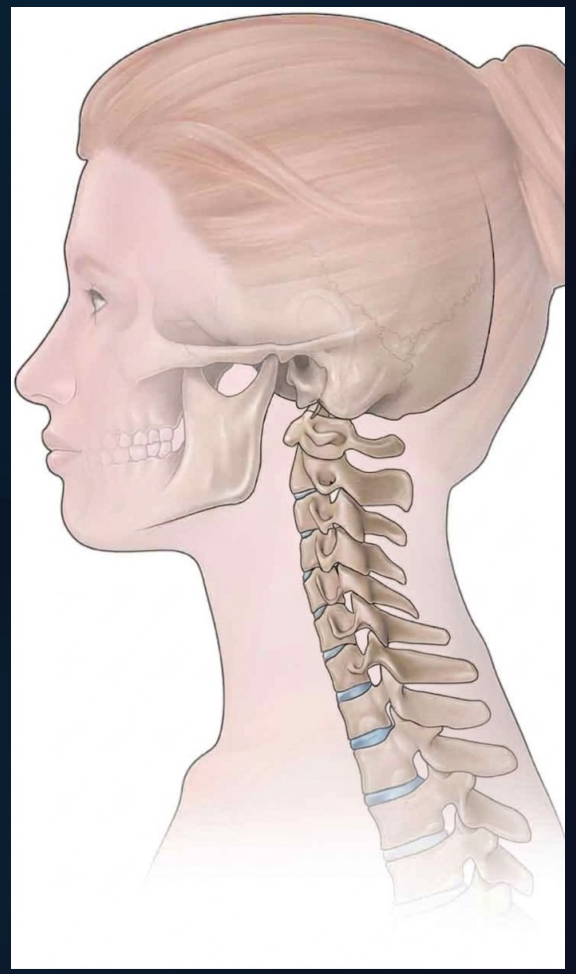
AI Vision: Language Vision Models





CT Scan: Cervical Spine

AI Vision: Language Vision Models



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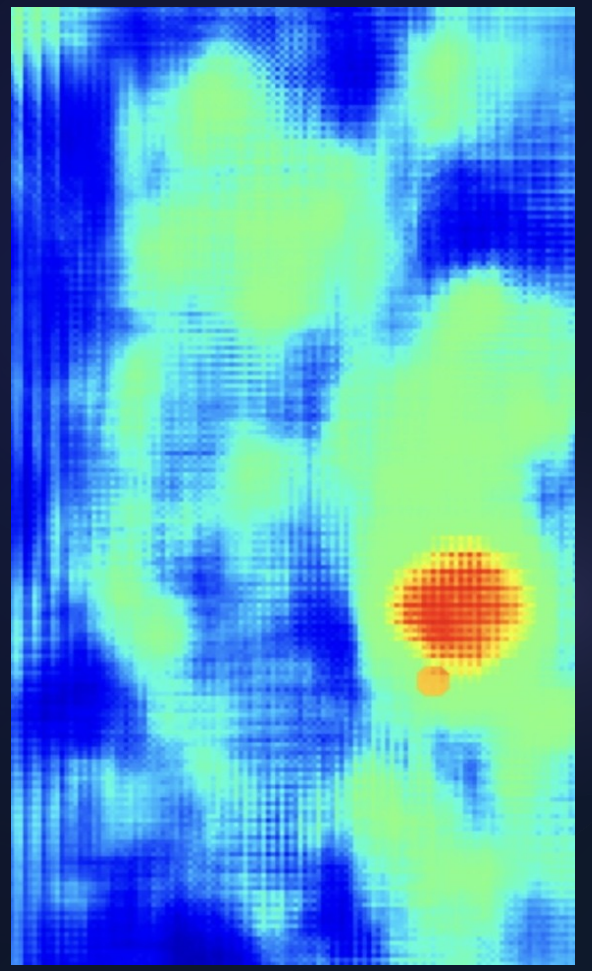

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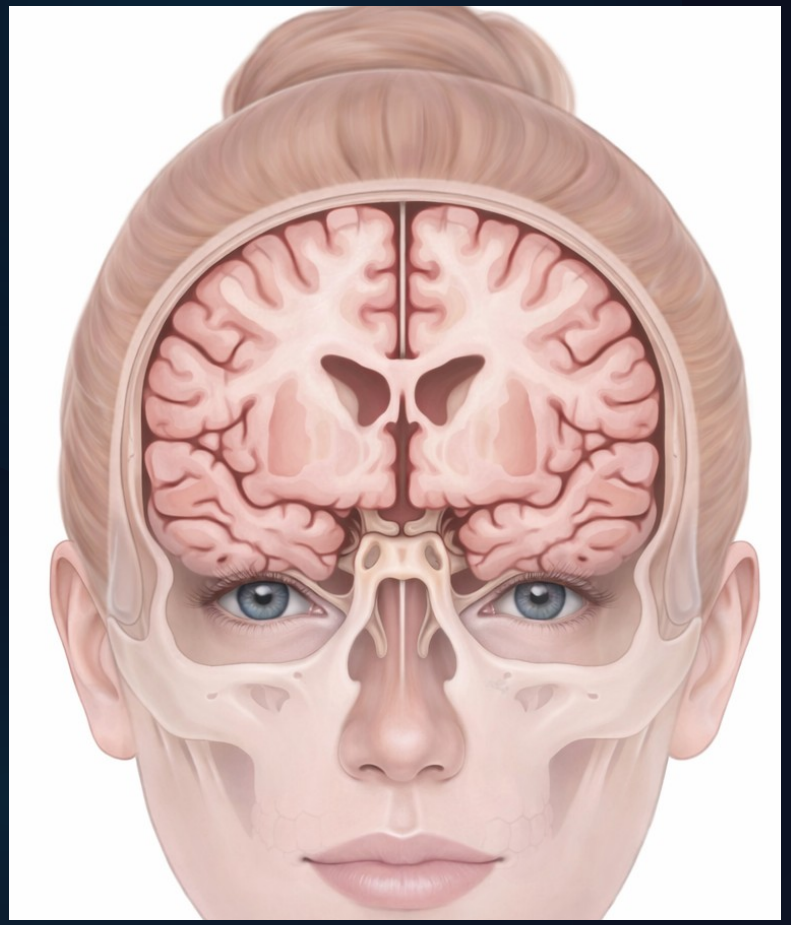
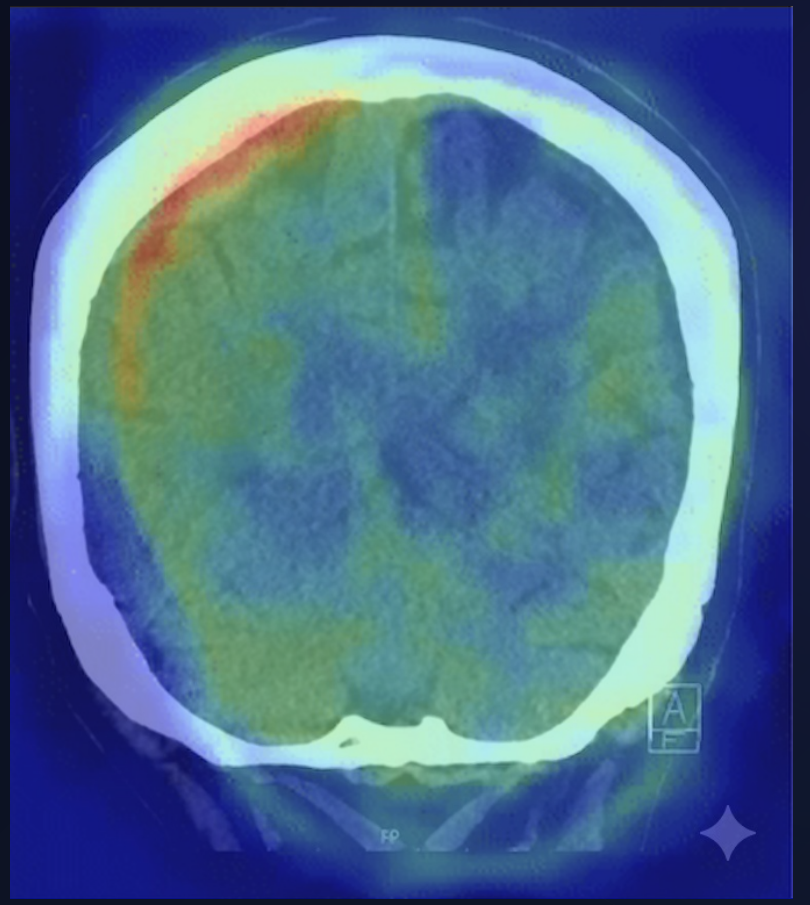
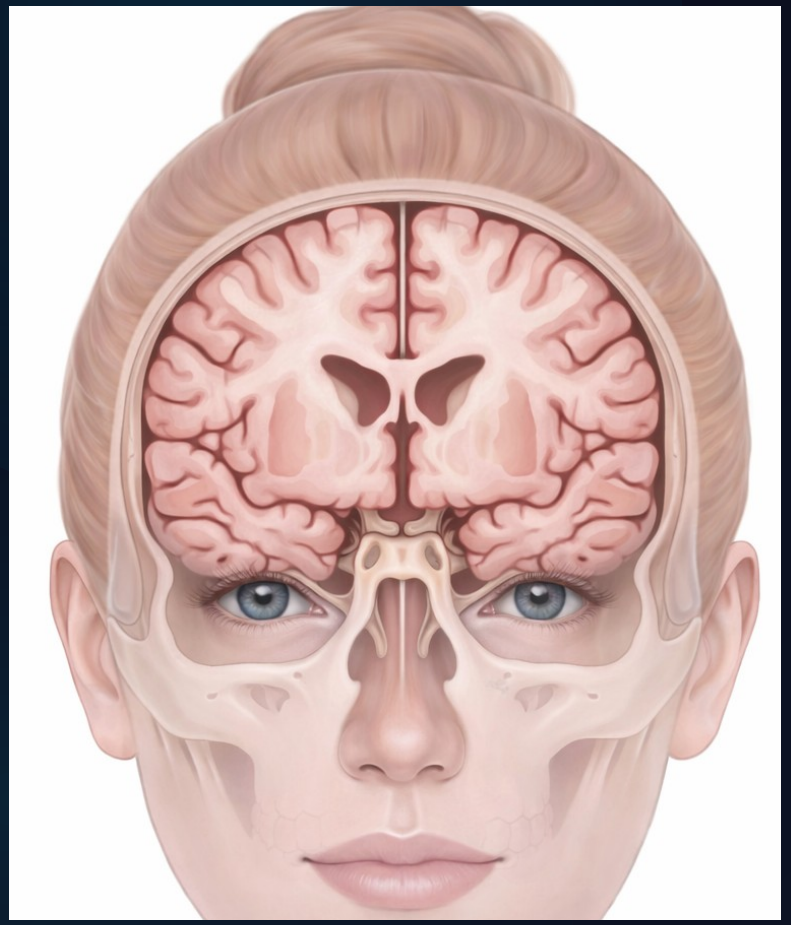
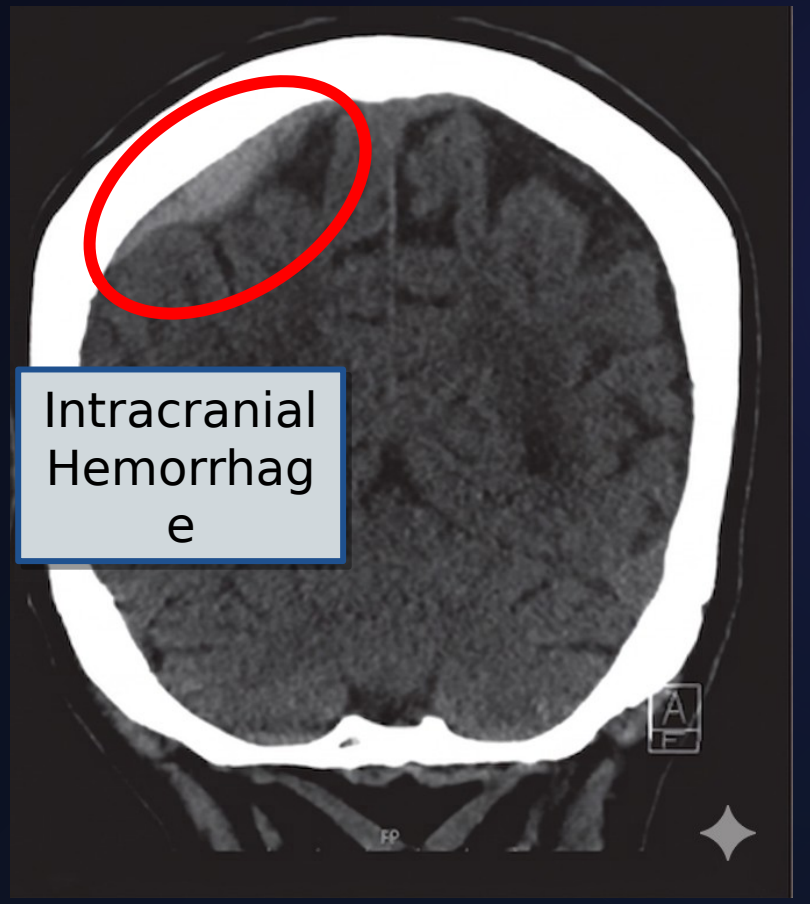




CT Scan: Brain

AI Vision: Language Vision Models





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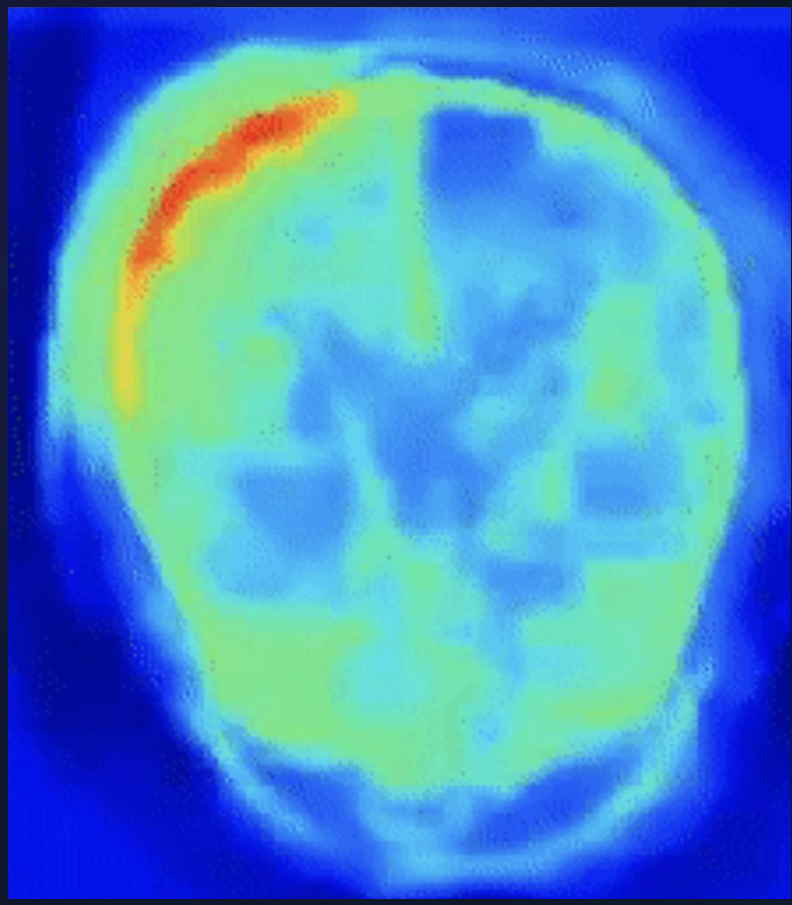

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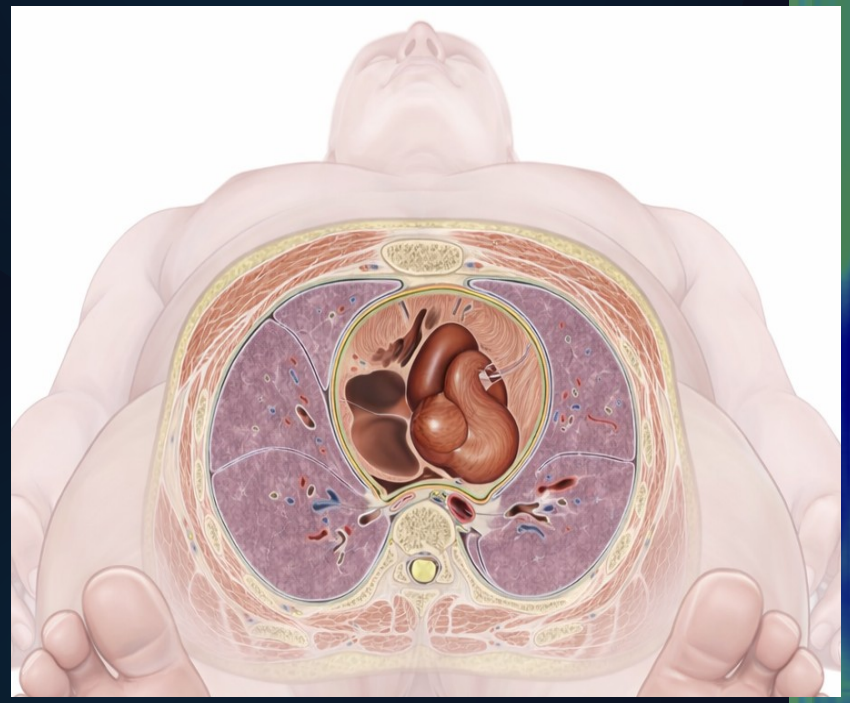
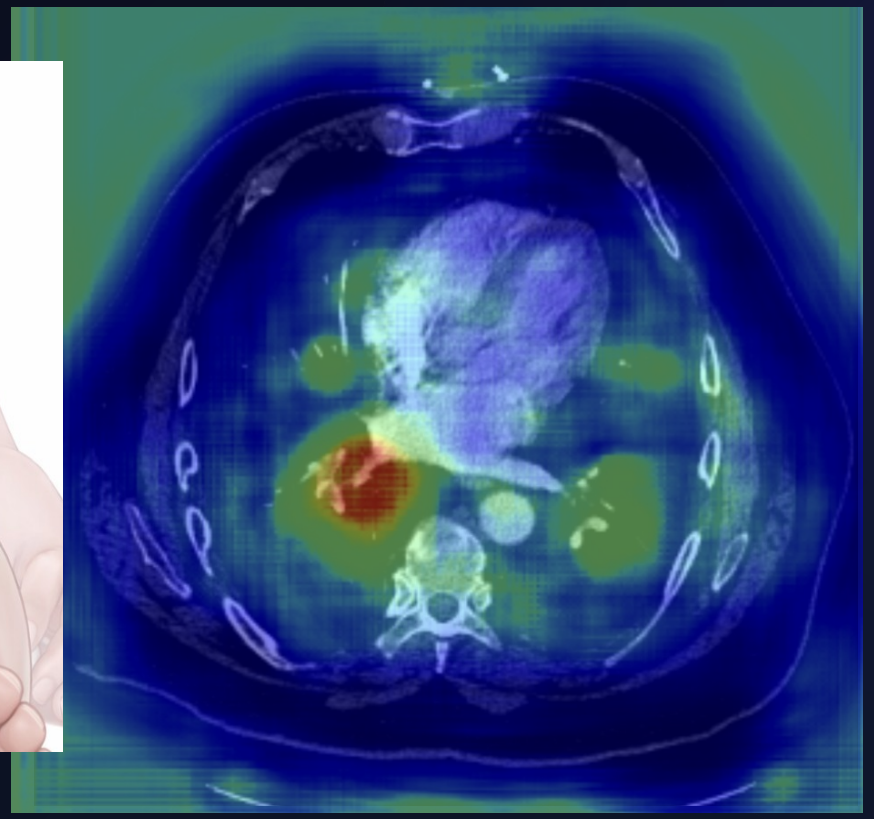
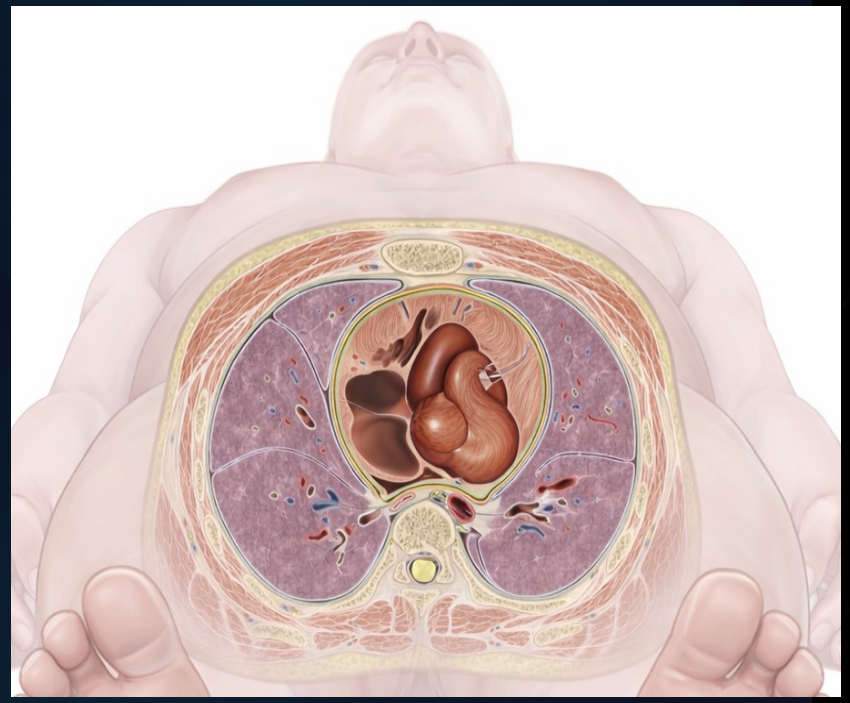


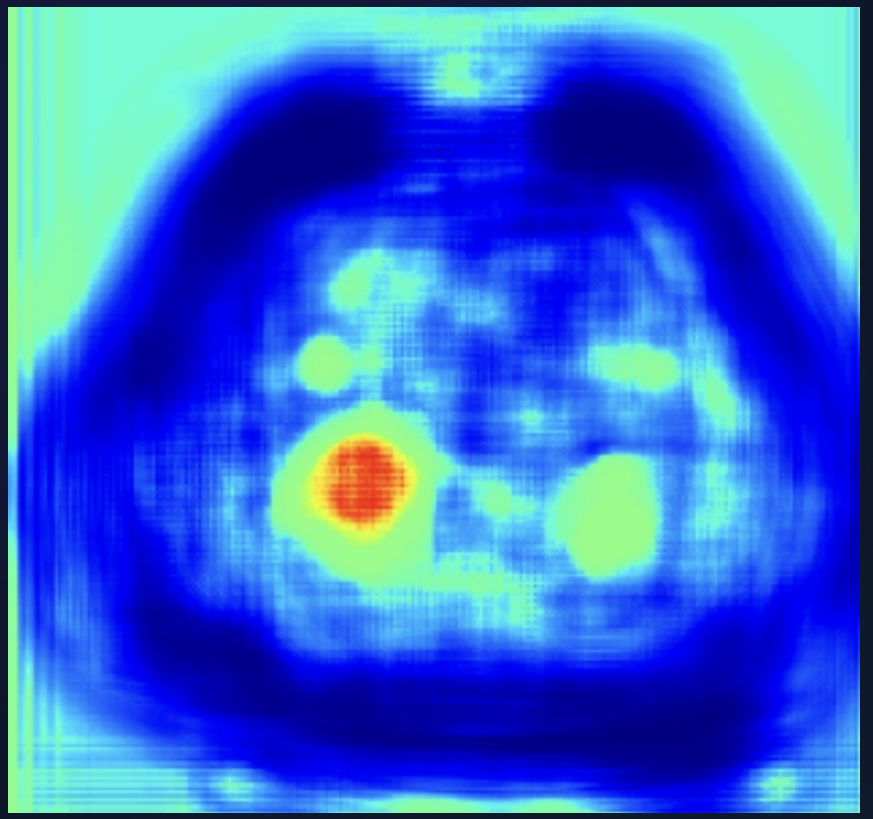


CT Scan: Chest

AI Vision: Language Vision Models

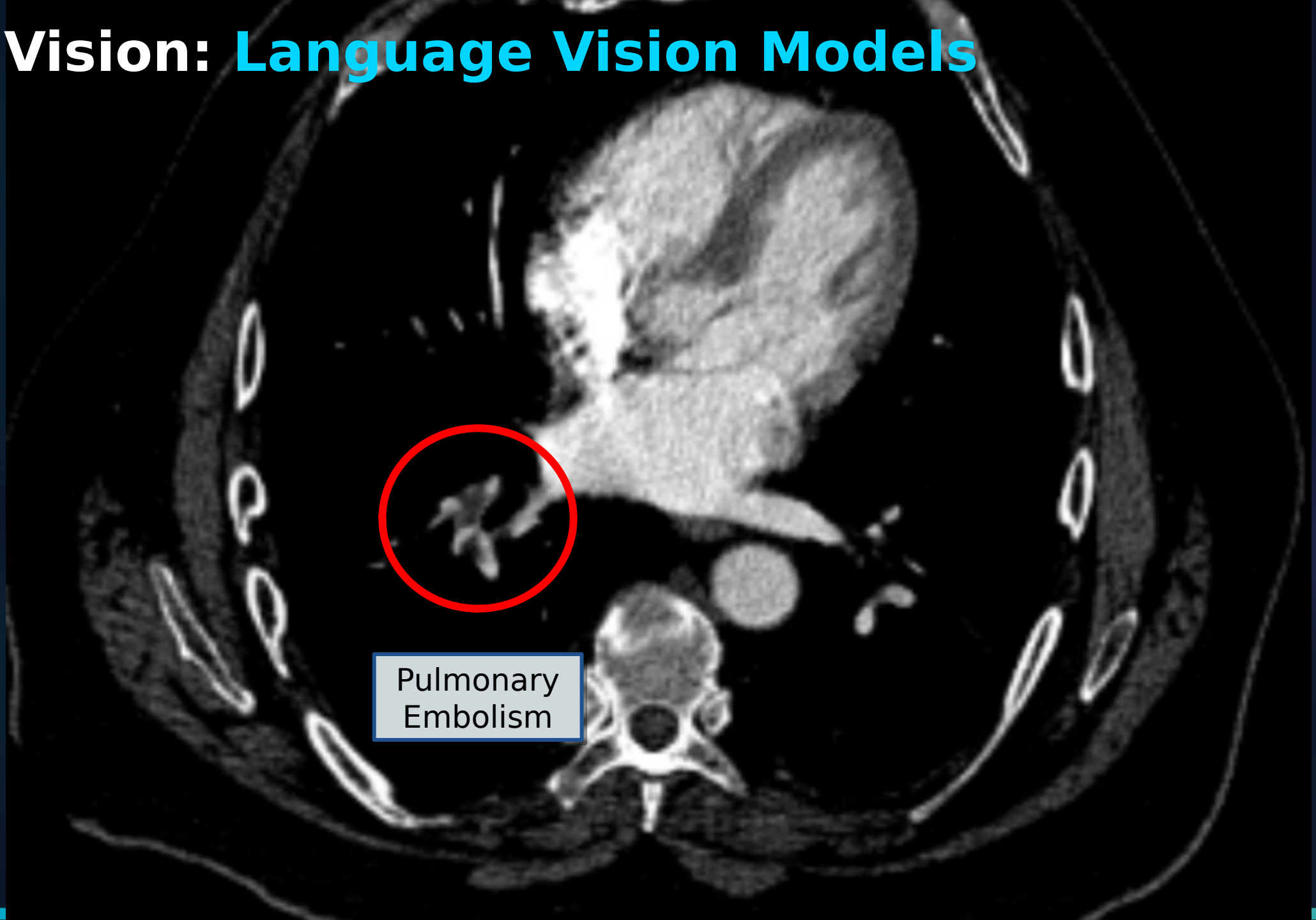


CT Scan: Chest



AI Vision: Chest

AI Vision: Language Vision Models



Language Models — Rapid Report Generation

RADIOLOGIST DICTATION

"CTA chest... no PE main or lobar... subseg maybe right lower... small bilateral effusions... heart size wnl... no pneumothorax... f/u as needed..."

AI

STRUCTURED REPORT

CT Angiography, Chest

Pulmonary Arteries: No PE in main or lobar arteries. Possible subsegmental PE in right lower lobe.

Pleural: Small bilateral pleural effusions.

Heart: Normal in size.

The radiologist speaks in shorthand. AI produces a polished, structured report.

HOW TO READ A CHEST X-RAY

ATMLL

ARE THERE MANY LUNG LESIONS

A: Abdomen

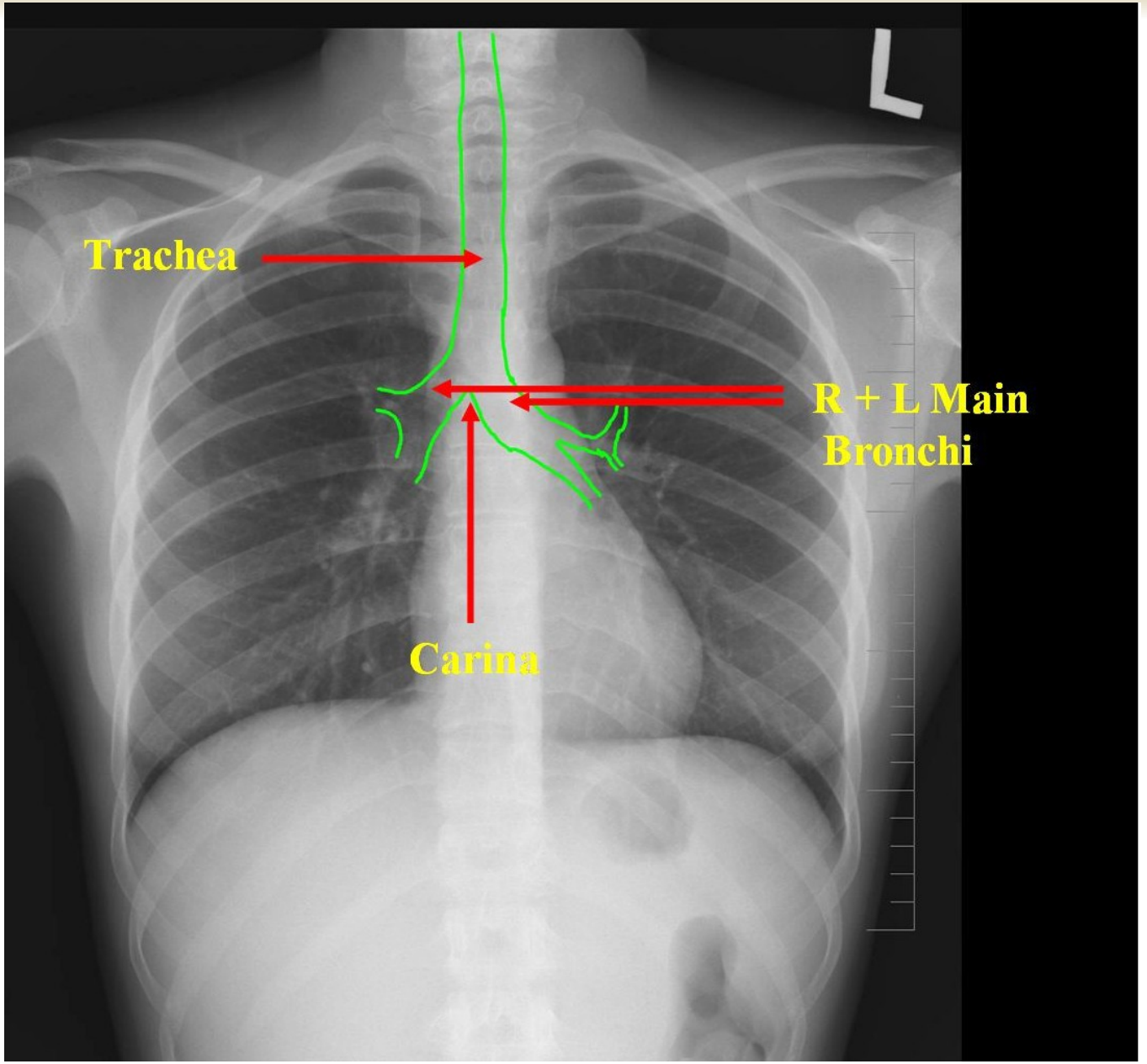
T: Thorax

M: Mediastinum

L: Lungs (unilateral)

L: Lungs (bilateral)

Tracheobronchial anatomy



Airways

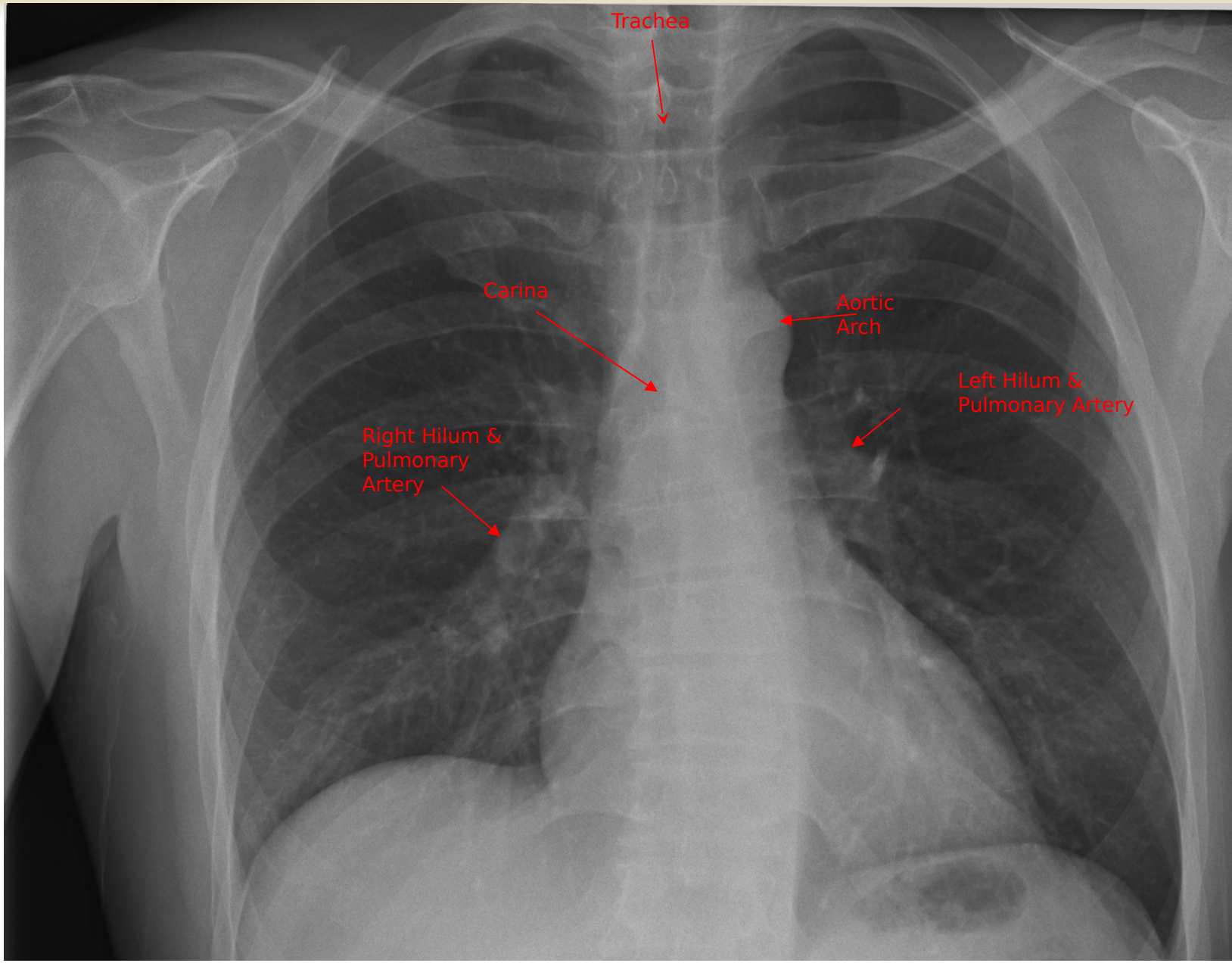
Start at the top in the midline and review the airways.

- trace down the trachea to the carina
  - is it straight and midline?
  - is there any narrowing?
- trace down both main bronchi
  - is the carina wide (more than 100 degrees)?
  - is there bronchial narrowing or cut-off?
  - is there any inhaled foreign body?

Breathing

Look for lung and pleural pathology.

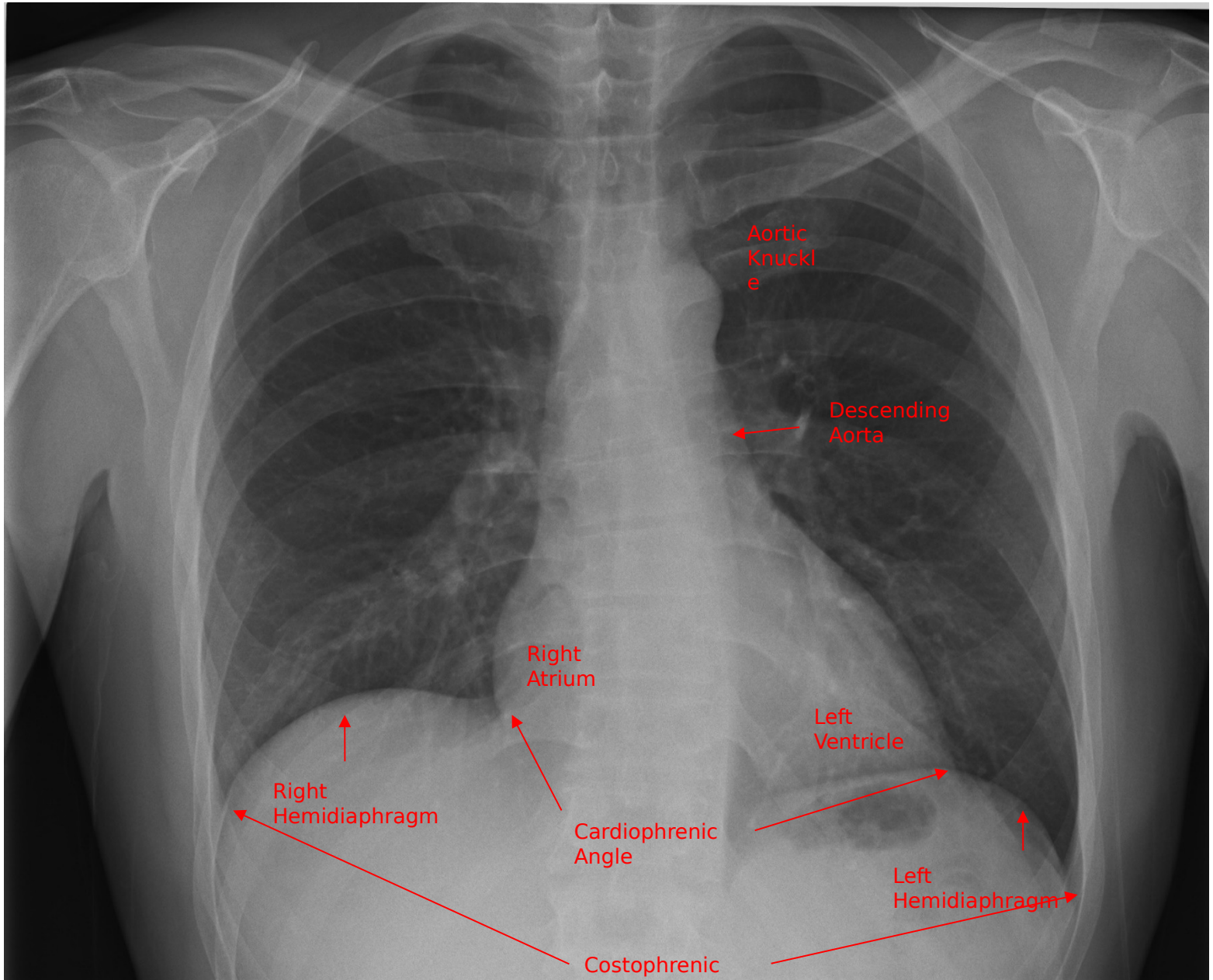
- both lungs should be well expanded and similar in volume
  - can you count 10 posterior ribs bilaterally?
  - is one lung larger than the other?
- compare the apical, upper, middle and lower zones in turn
  - are they symmetrical?
  - are there areas of increased density?
- trace the lung vessels
  - do they branch out progressively and uniformly?
  - can you see the retrocardiac and retrodiaphragmatic lung vessels?
  - are there extra lines in the periphery that aren't vessels?
- trace the lateral margins of the lung to the costophrenic angles
  - are the costophrenic angles crisp?
- trace the hemidiaphragms in to the vertebra
  - can you see the whole of the hemidiaphragm?
- trace the cardiac borders
  - can you clearly see the left and right heart border?
  - can you see the descending aorta?

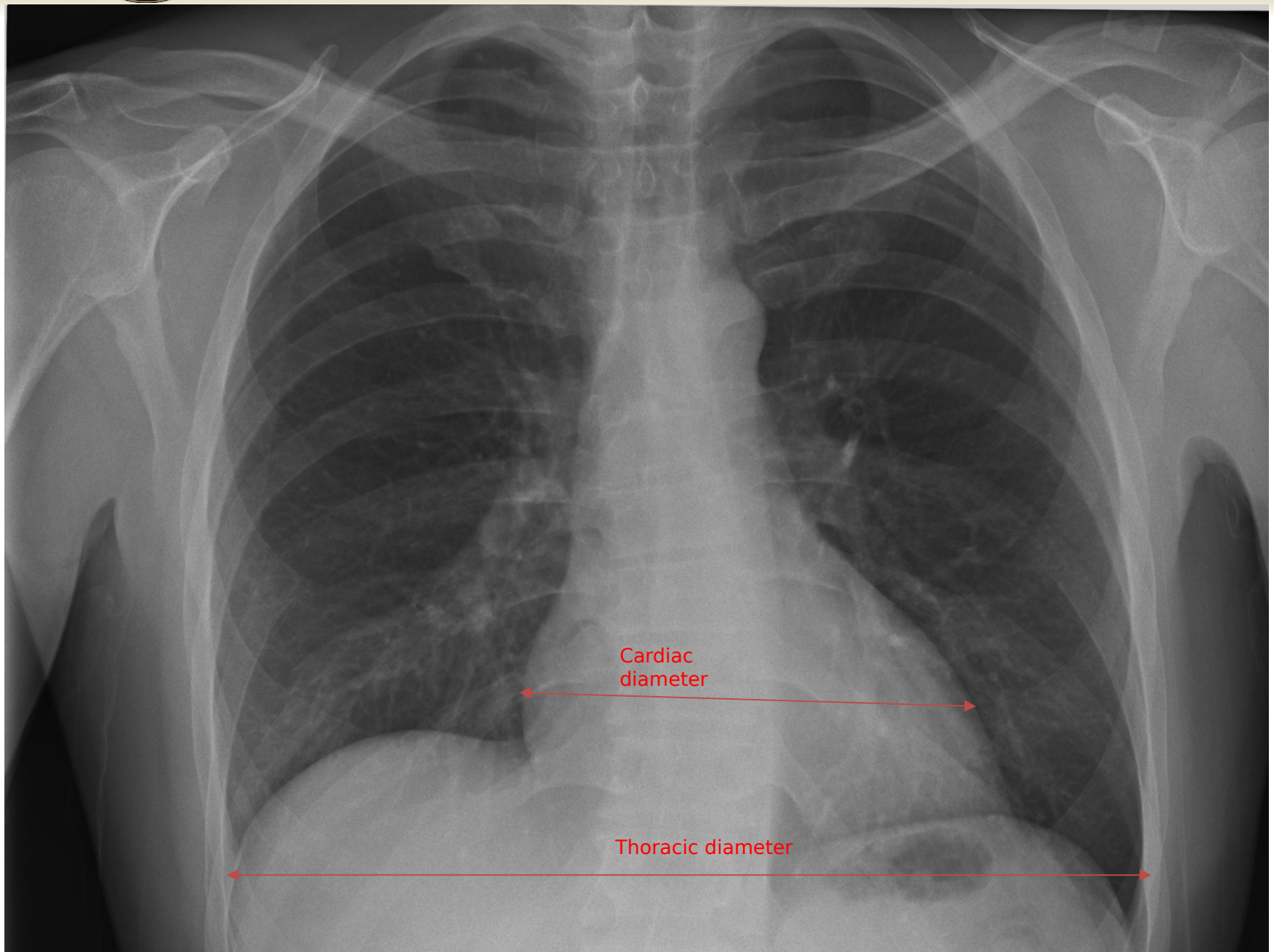


Circulation

Look at the heart and vessels (systemic and pulmonary).

- check the cardiac position
  - is 1/3 to the right and 2/3 to the left?
- assess cardiac size
  - is the cardiothoracic ratio < 50%?
- check the position and size of the aortic arch and pulmonary trunk
- check the width of the upper mediastinum
- look at the hilar vessels
  - can you see them clearly on both sides?
  - are they at a similar height?
  - can you see a preserved hilar point bilaterally?





Cardiothoracic Ratio greater than 1:2 is considered abnormal

Disability

Check for any bony pathology (fracture or metastasis).

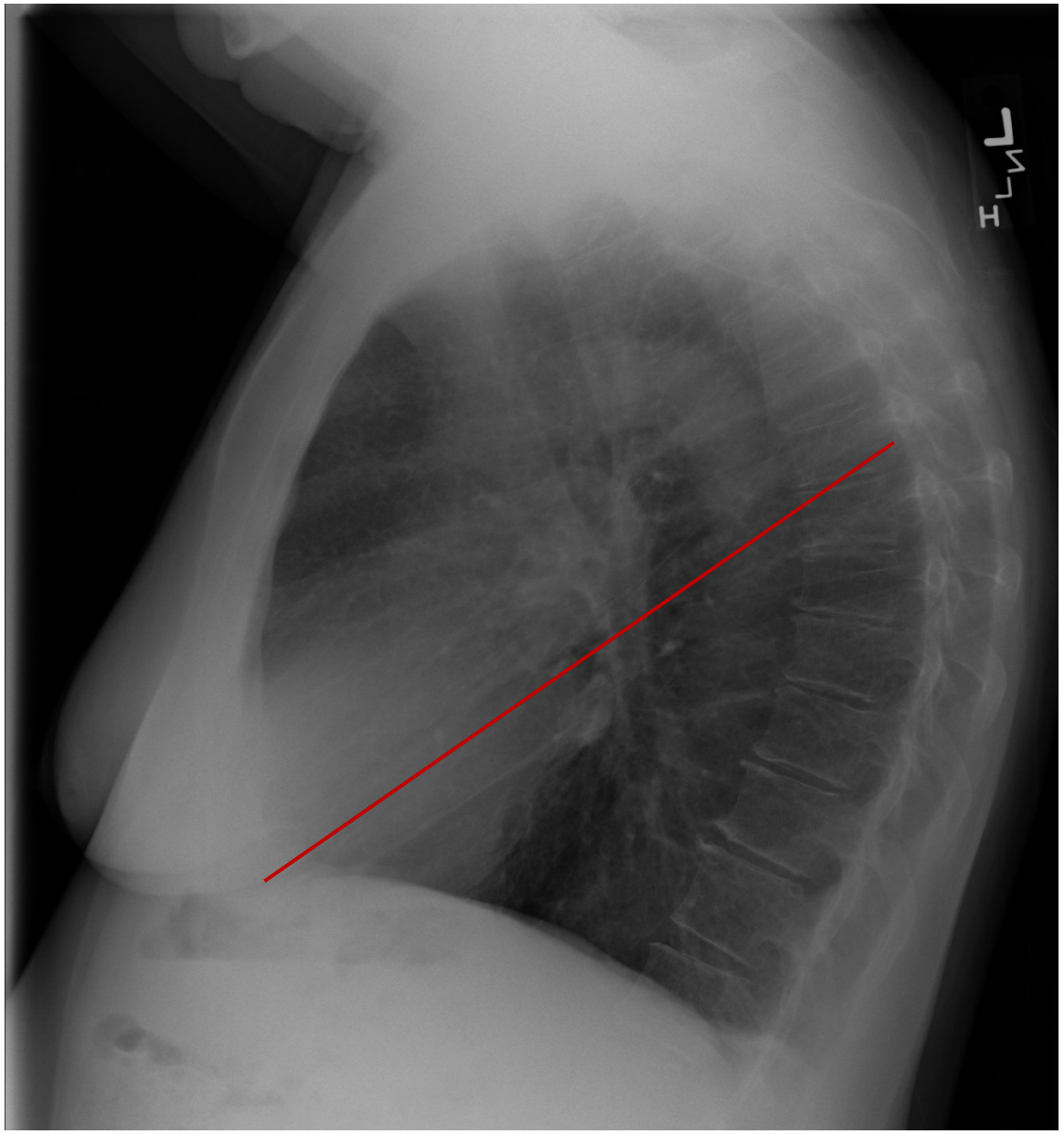
- trace along each posterior (horizontal) rib on one side of the chest
  - is there a fracture or abnormal area?
- repeat with the other side of the chest
- now trace lateral and anterior ribs on the first side
- repeat on the other side
- now, check the clavicles and shoulders
  - can you trace around the cortex of the bones?
- finally the check the vertebral bodies
  - are they all rectangular and of a similar height?
  - can you see 2 pedicles per vertebral body?
  - are there disc spaces?

Everything else

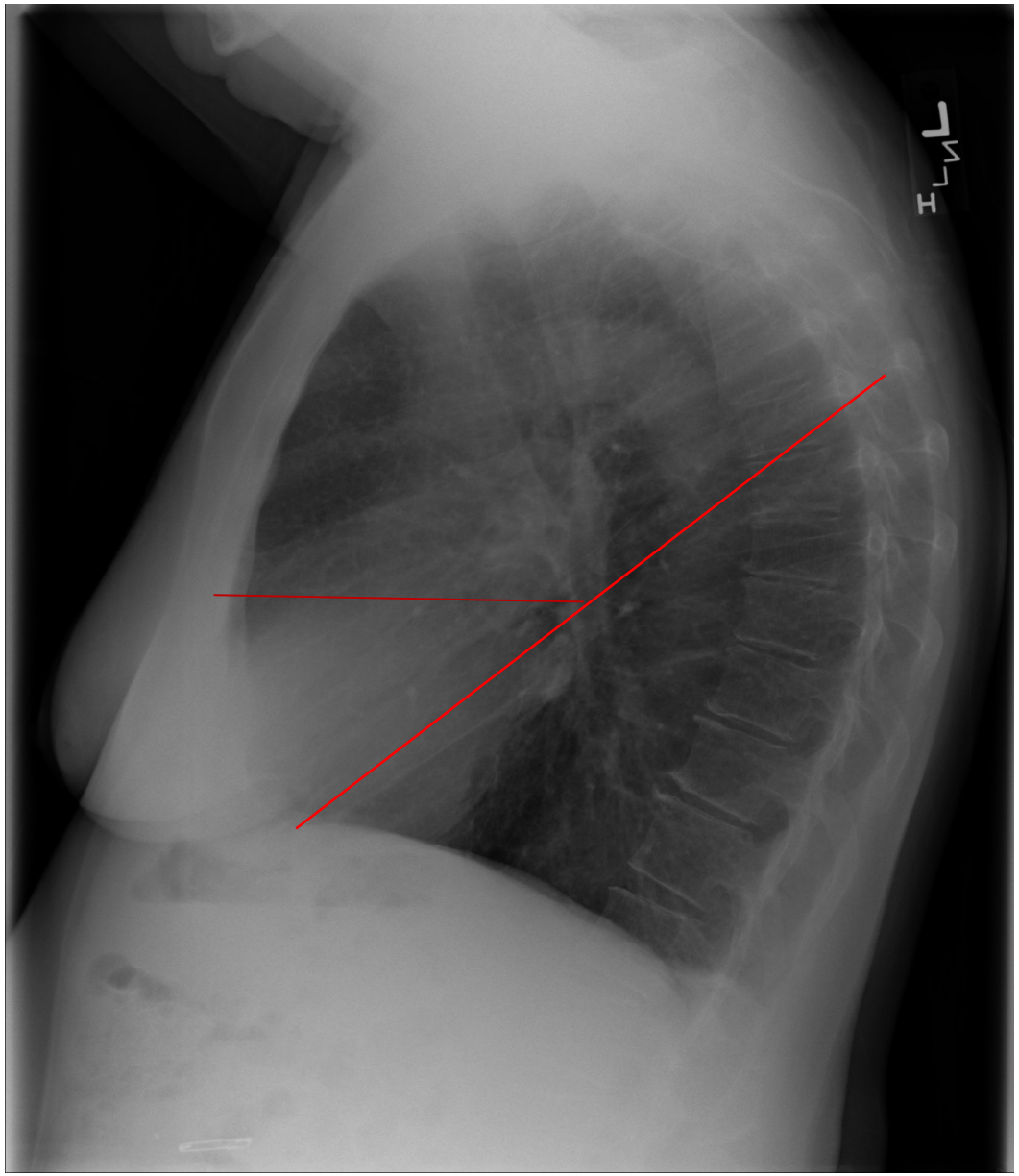
Review the upper abdomen, soft tissues and take a look at some final check areas.

- is there free gas under the diaphragms?
- is there subcutaneous emphysema?
- is the gastric bubble in the correct place?
- is there a hiatus hernia?
- is there an absent breast shadow?
- are there any surgical clips?
- check again...
    - are the lung apices clear?
    - is there any retrocardiac or retrodiaphragmatic pathology?

Normal
Chest X-ray
Lateral
view



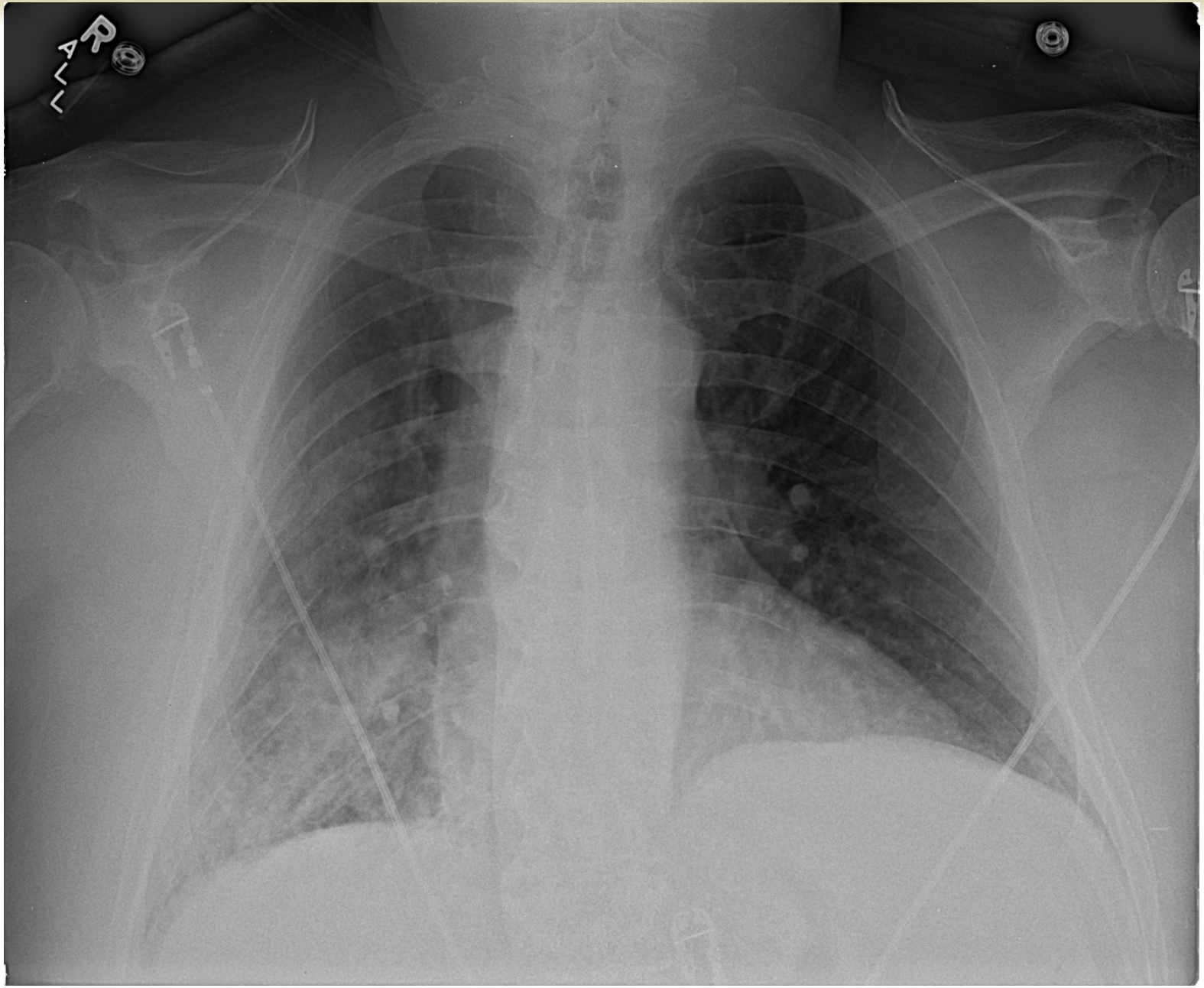
Major fissure of left lung in Lateral view



Major and minor fissures of right lung in Lateral view

Case 1

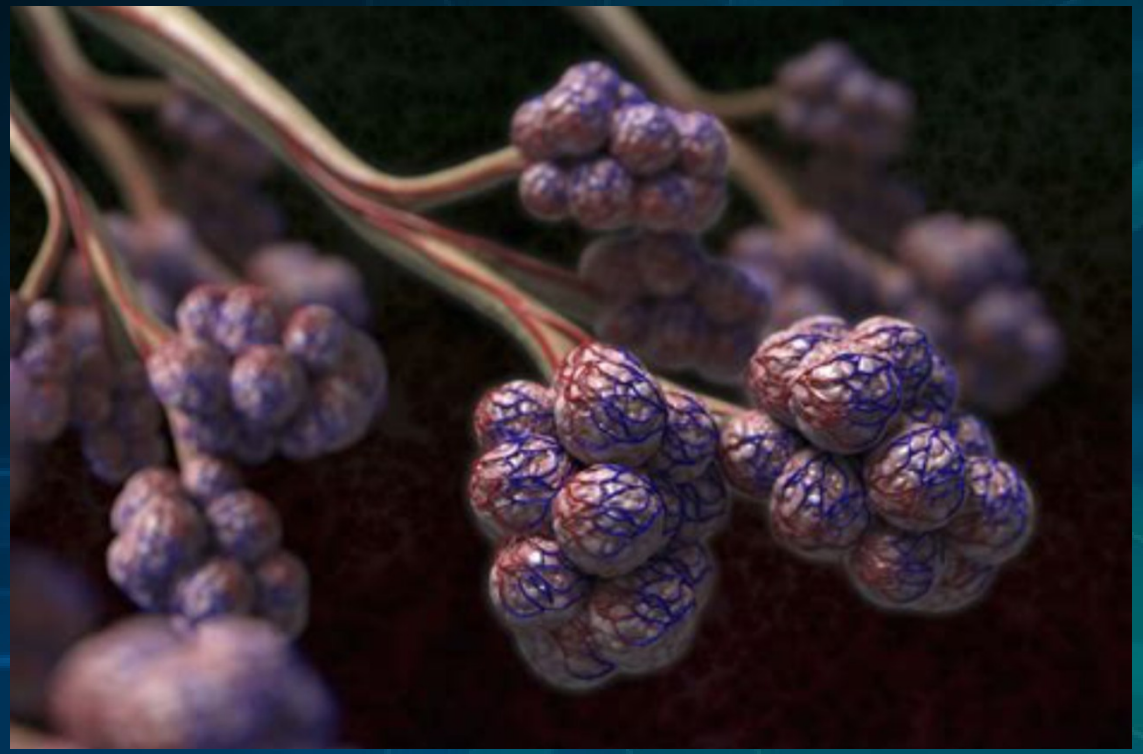
A 35-year-old man comes to the ED with fever, dyspnea, and a productive cough. His symptoms began suddenly 2 days ago. He smokes one pack of cigarettes daily. His temperature is 38.8°C (101.8°F), pulse is 110/min, respirations are 24/min, and blood pressure is 105/74 mm Hg. Pulse oximetry on room air shows an oxygen saturation of 92%. Examination reveals crackles over the right lower lung base. The remainder of the examination shows no abnormalities.


R
ALL

Case 1 - Pneumonia

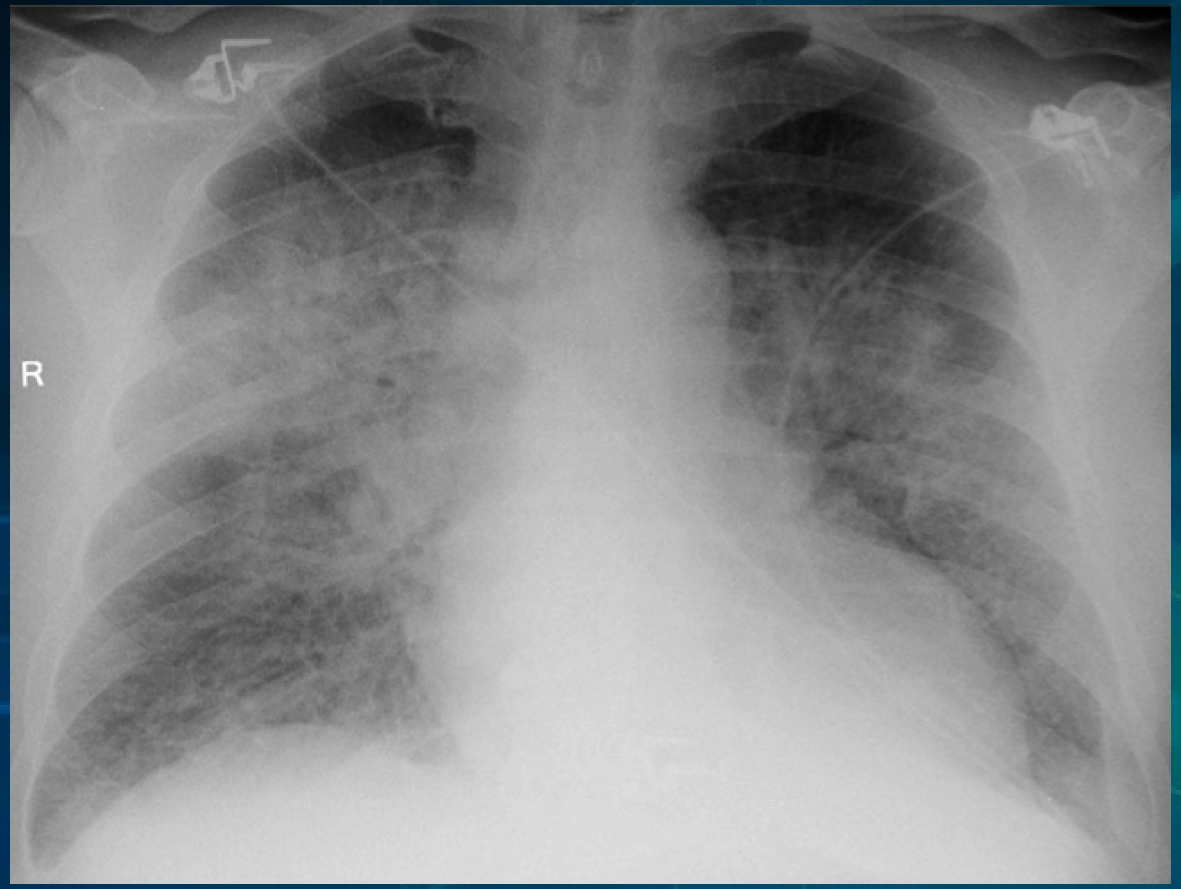
- Infection in the lung
- Purulent material filling the alveoli
- Consolidation with air bronchograms
- Lobar vs Multilobar
- Often has a parapneumonic effusion

Chest Radiography: Airspace disease



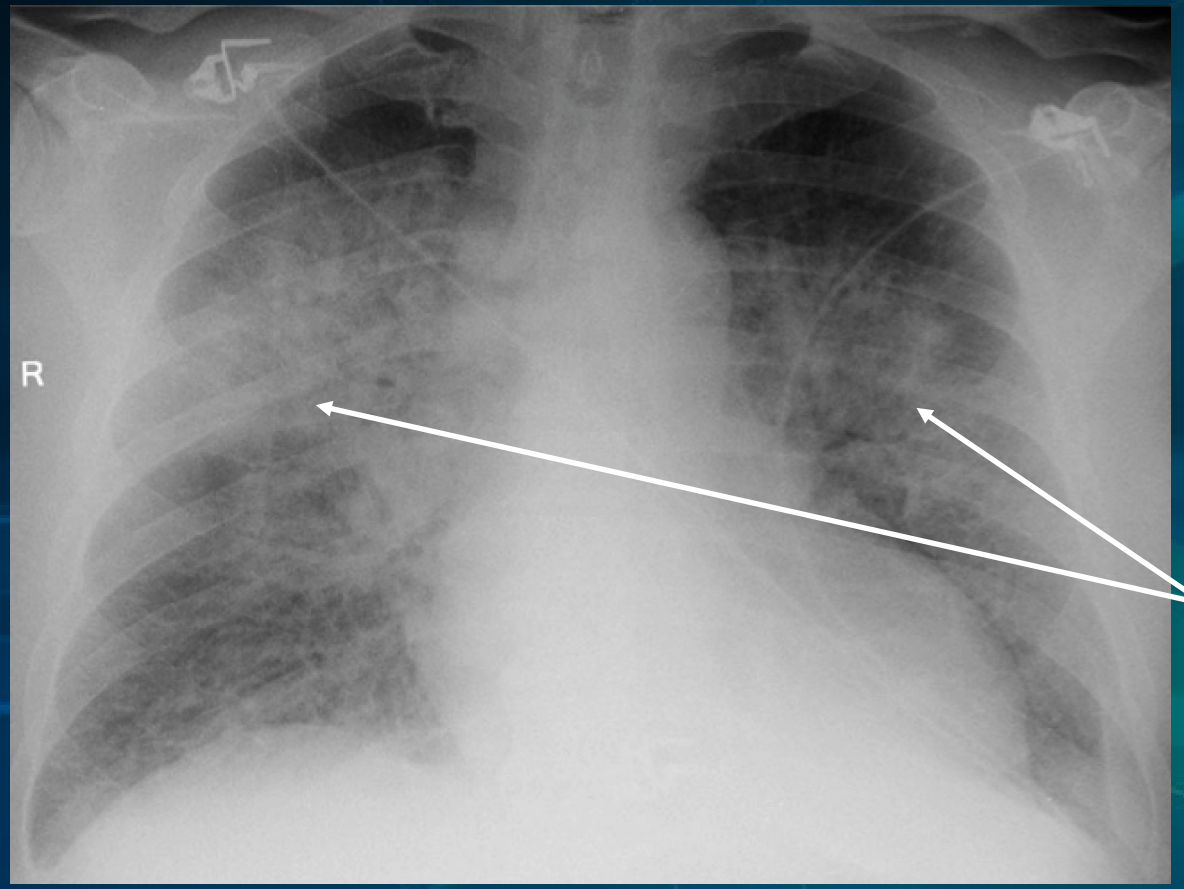
Filling of alveolar air spaces with fluid results in “airspace opacities” on radiographs

Chest Radiography: Airspace disease



Airspace opacities
“Hazy”
“Fluffy”
“Cloud-like”

Chest Radiography: Airspace disease

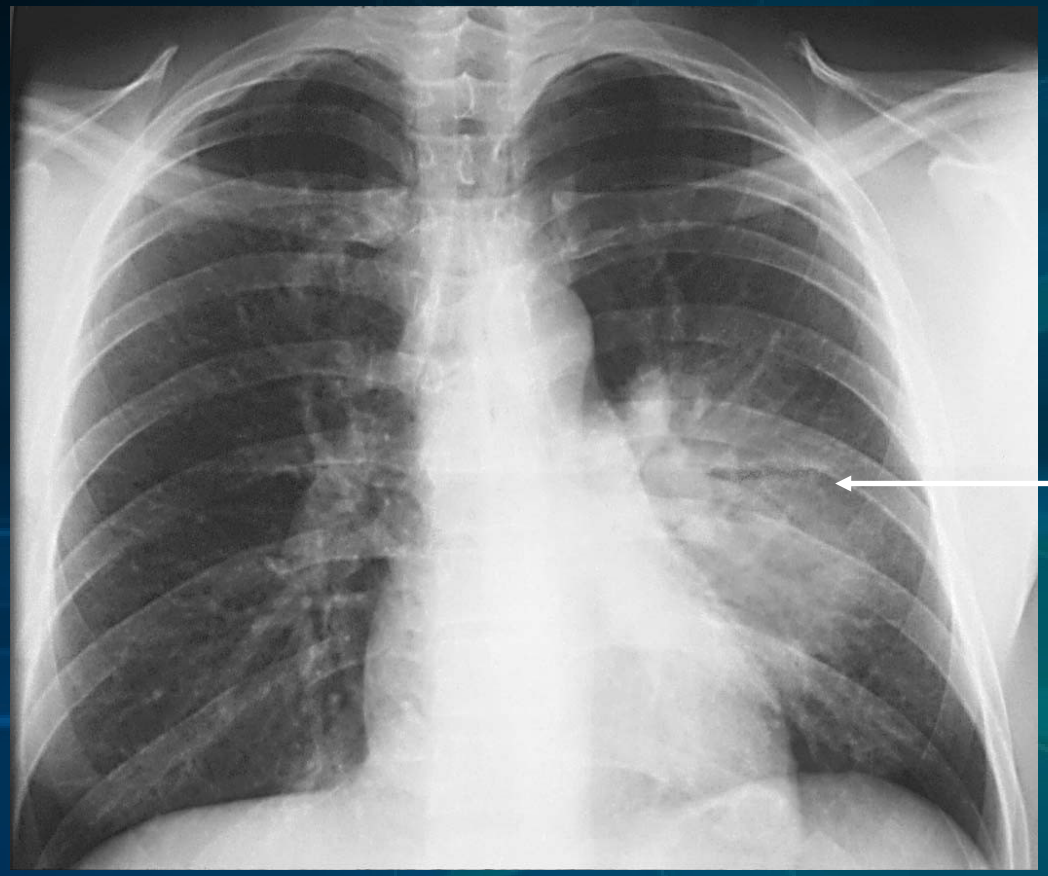


Airspace opacities
“Hazy”
“Fluffy”
“Cloud-like”

Bilateral perihilar airspace opacities

CHF with pulmonary edema

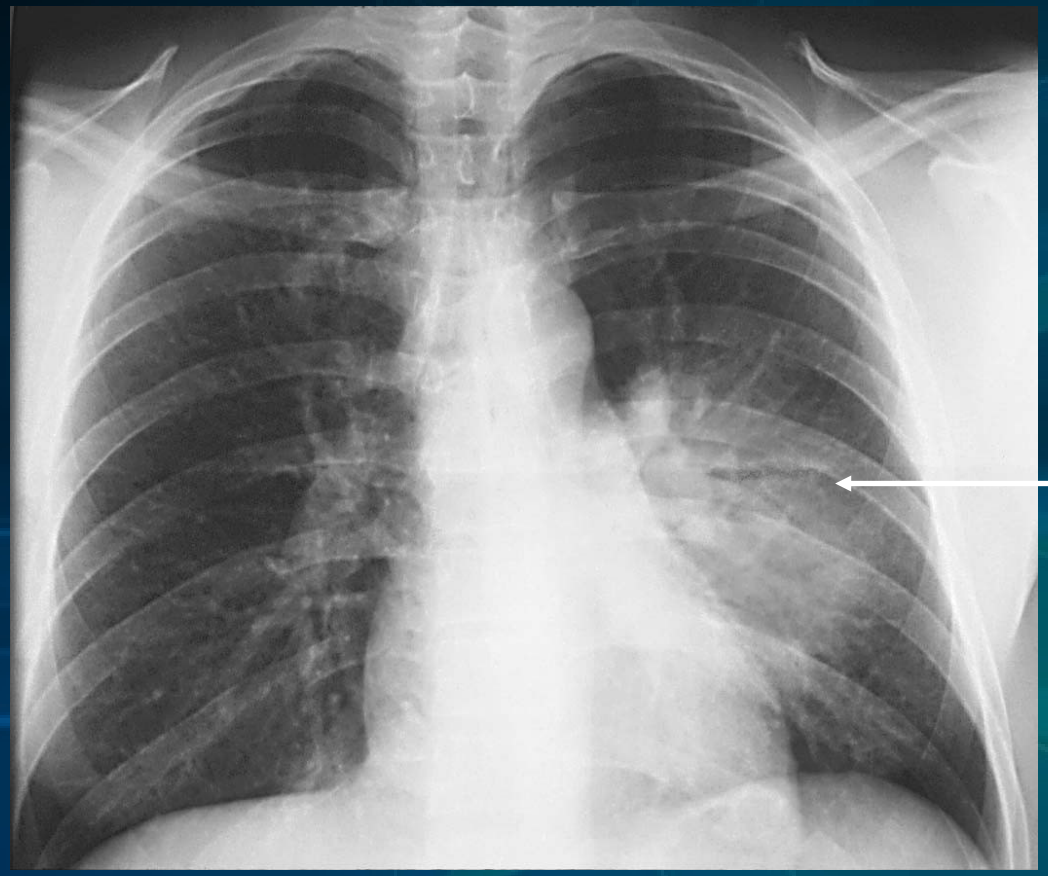
Chest Radiography: Airspace disease



Airspace opacities
When confluent and dense, airspace disease is termed "consolidation"

Can spare the bronchial tree, leaving aerated "air bronchograms"

Chest Radiography: Airspace disease



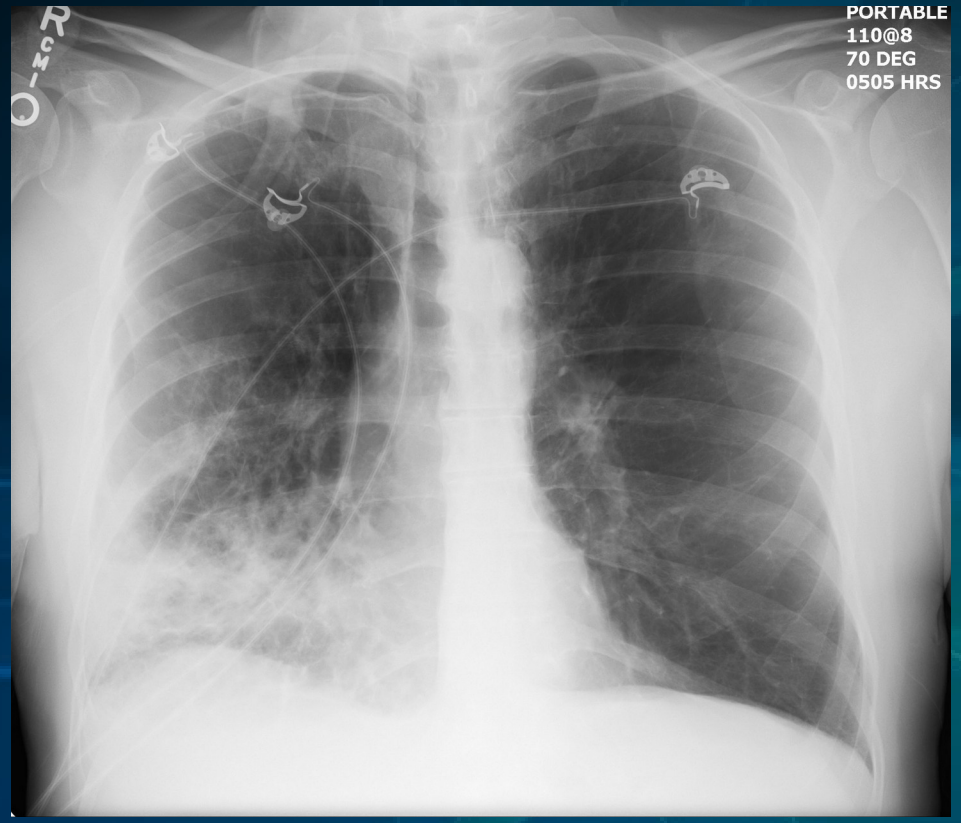
Airspace opacities
When confluent and dense, airspace disease is termed "consolidation"

Can spare the bronchial tree, leaving aerated "air bronchograms"

Left hilar consolidation with air bronchograms

Pneumonia

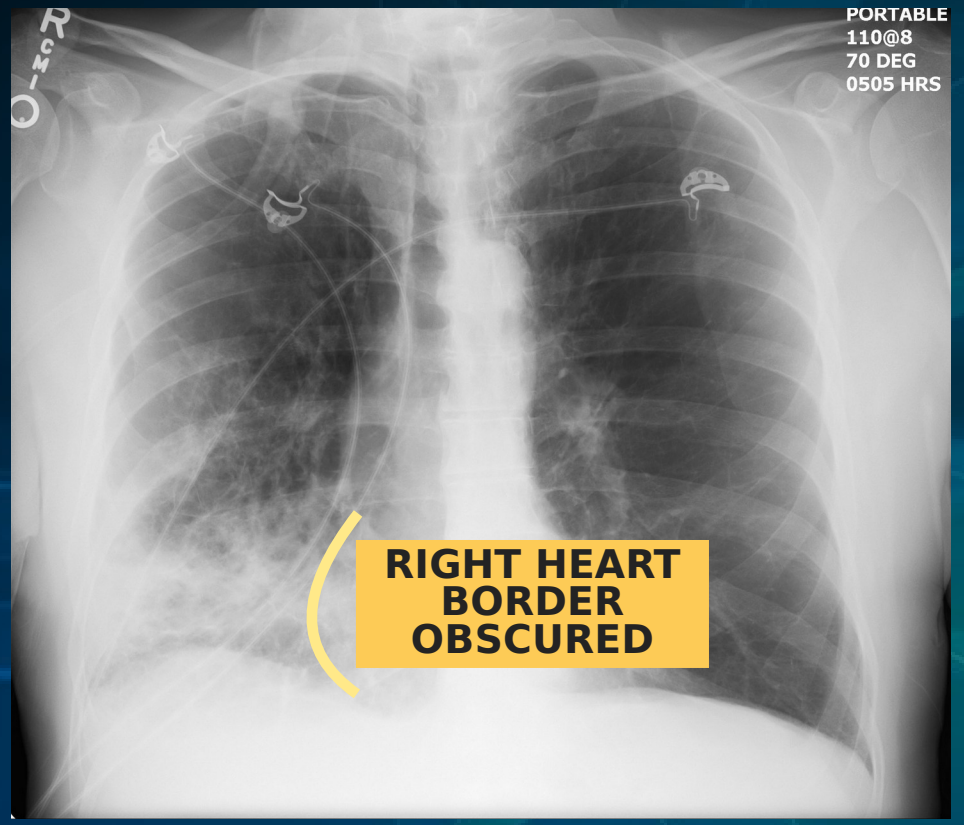
Chest Radiography: Airspace disease



Airspace disease

Loss of normal interface between opacified airspaces and adjacent anatomy, termed the “silhouette sign.”

Chest Radiography: Airspace disease



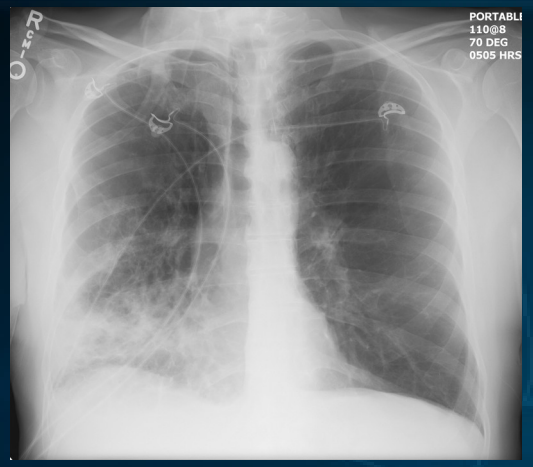
Airspace disease

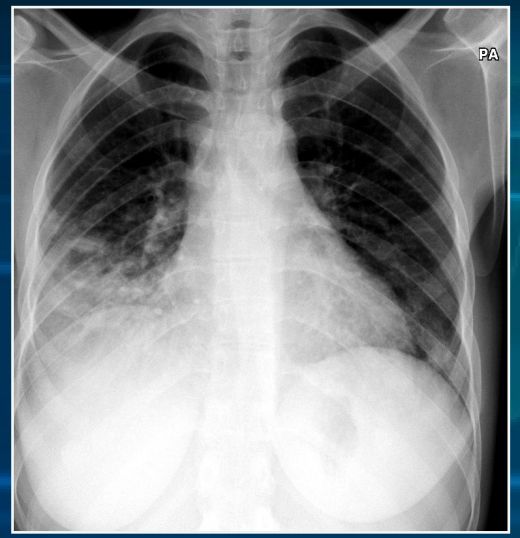
Loss of normal interface between opacified airspaces and adjacent anatomy, termed the "silhouette sign."

Consolidation of right lower lung zone, obscuring the right heart border

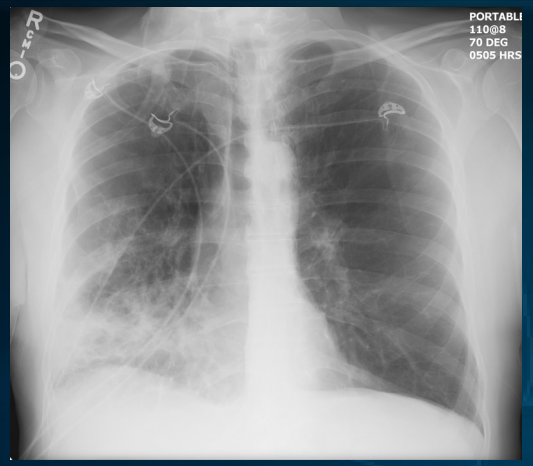
Right middle lobe pneumonia

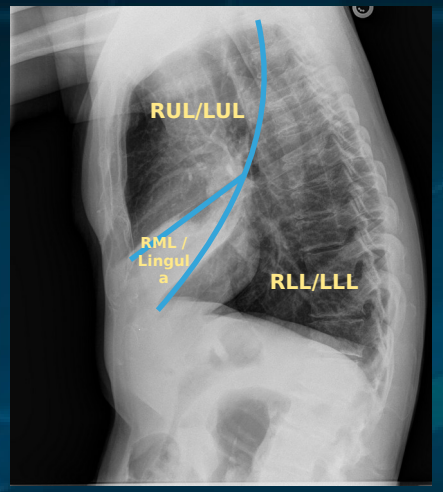
Chest Radiography: Airspace disease





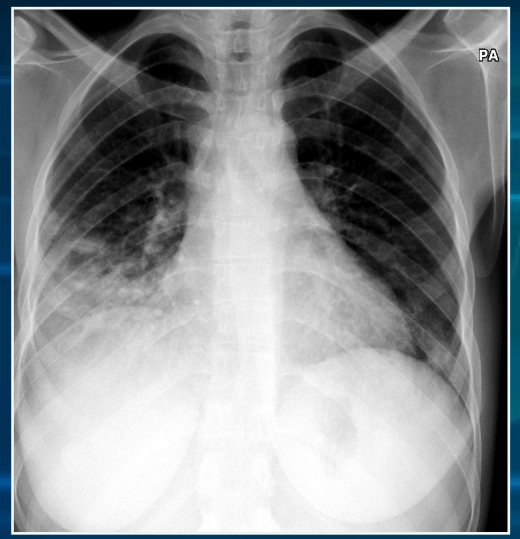
Chest Radiography: Airspace disease

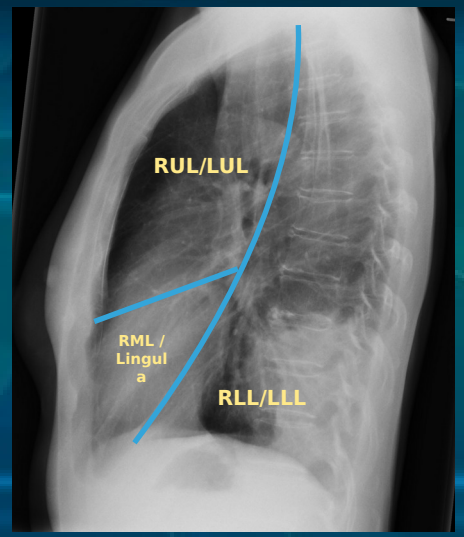




Consolidation of right lower lung zone, obscuring the right heart border

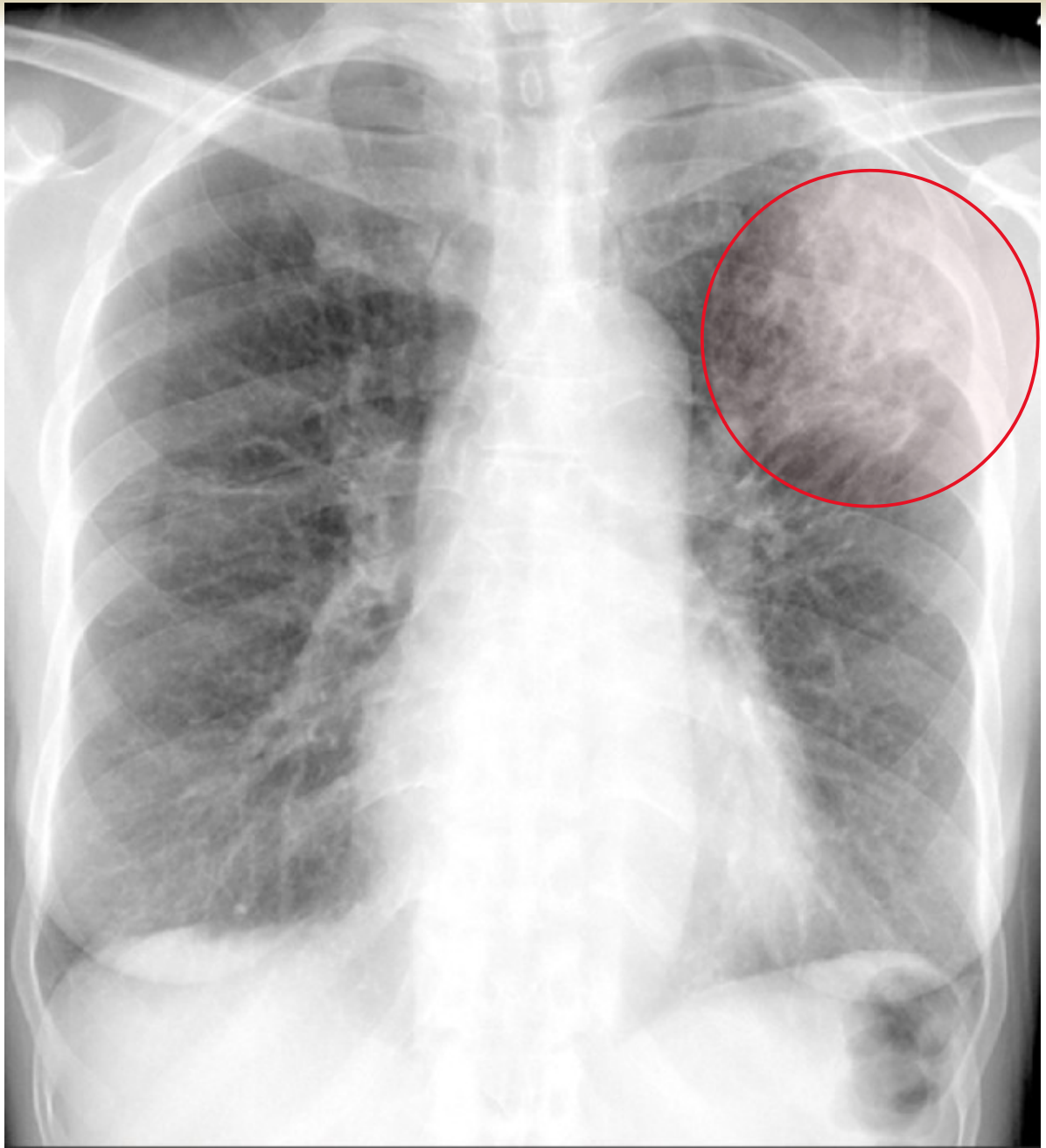
Right middle lobe pneumonia



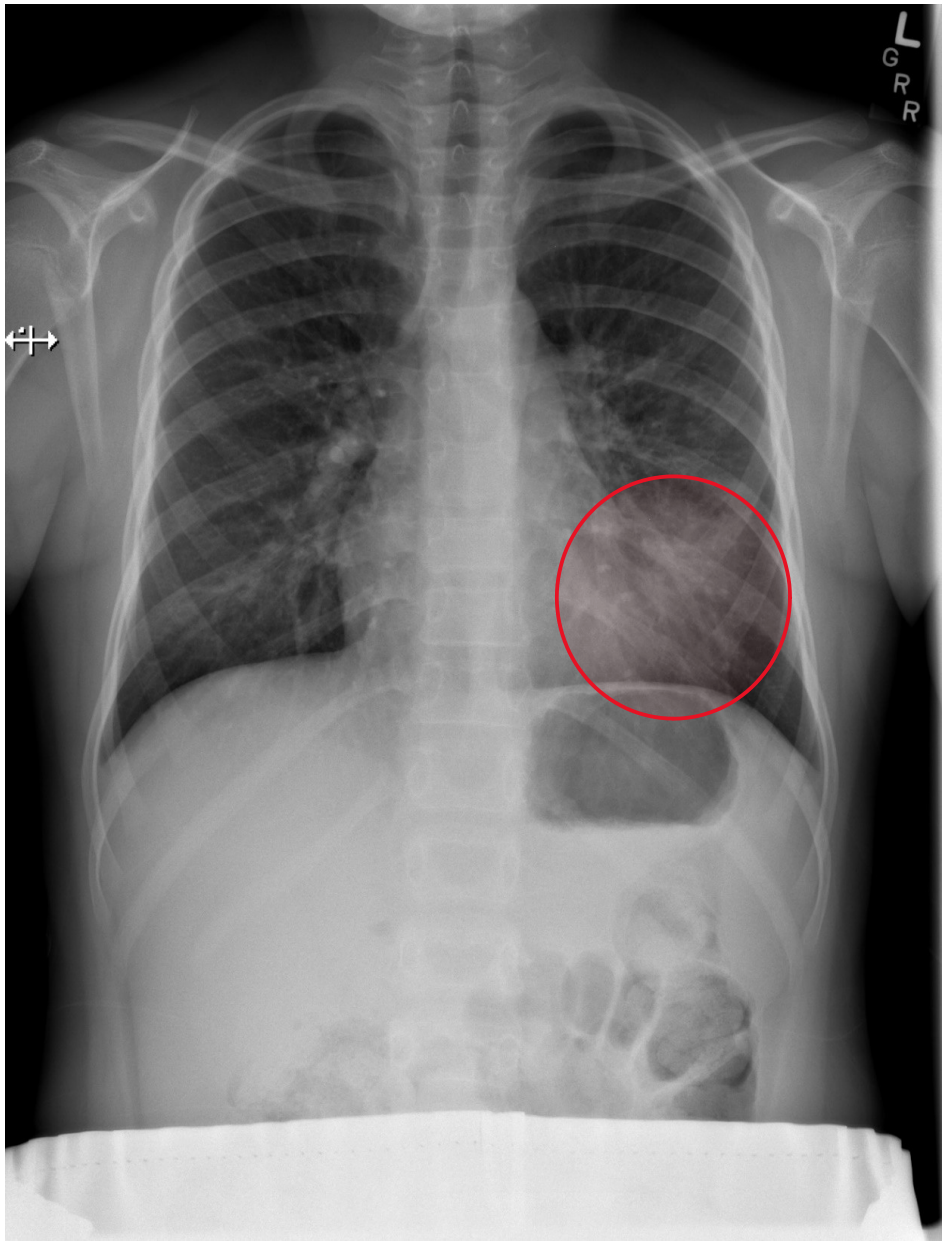


Consolidation of right lower lung zone, obscuring the right hemidiaphragm

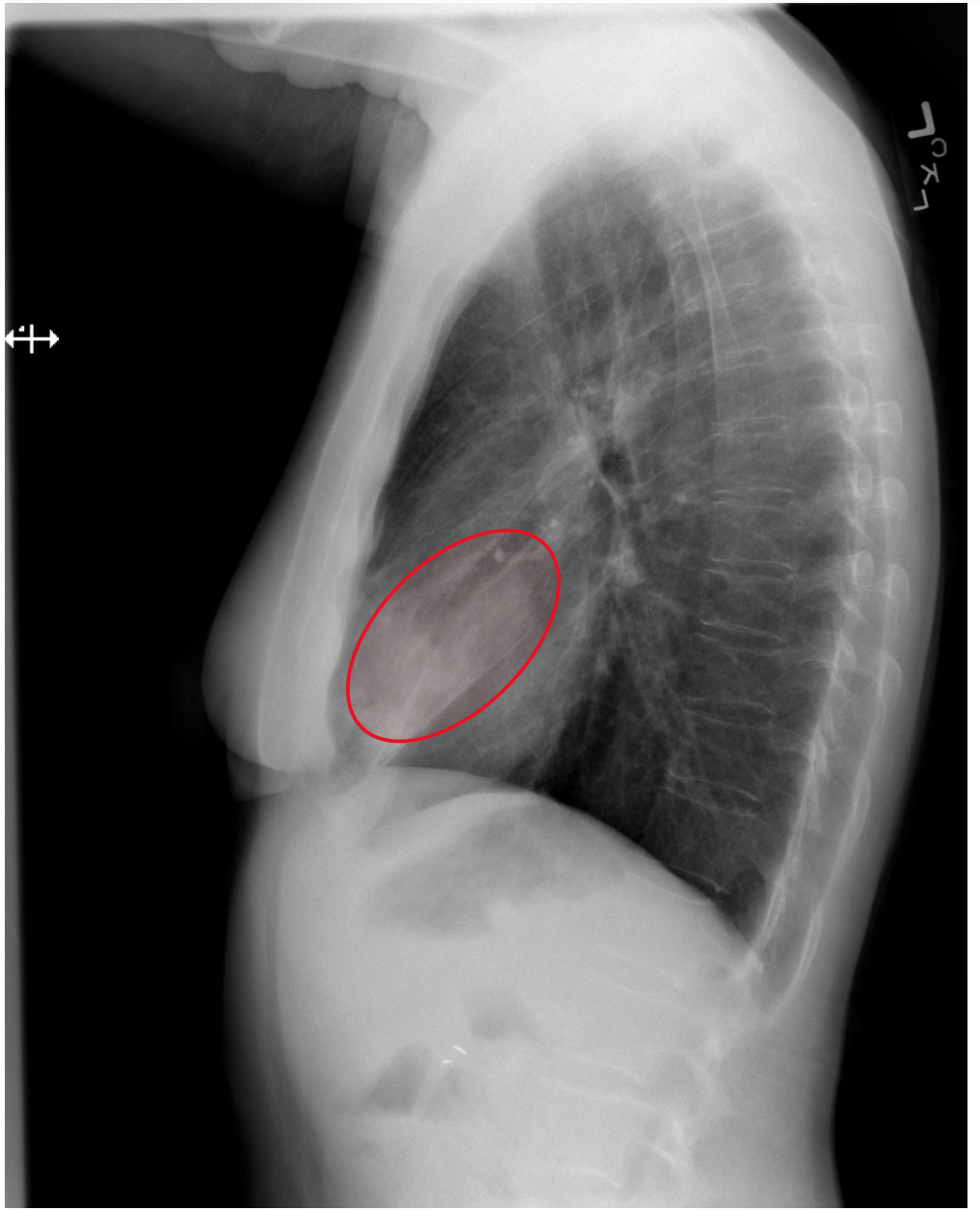
Right lower lobe pneumonia



Lobar consolidation



Lingular consolidation

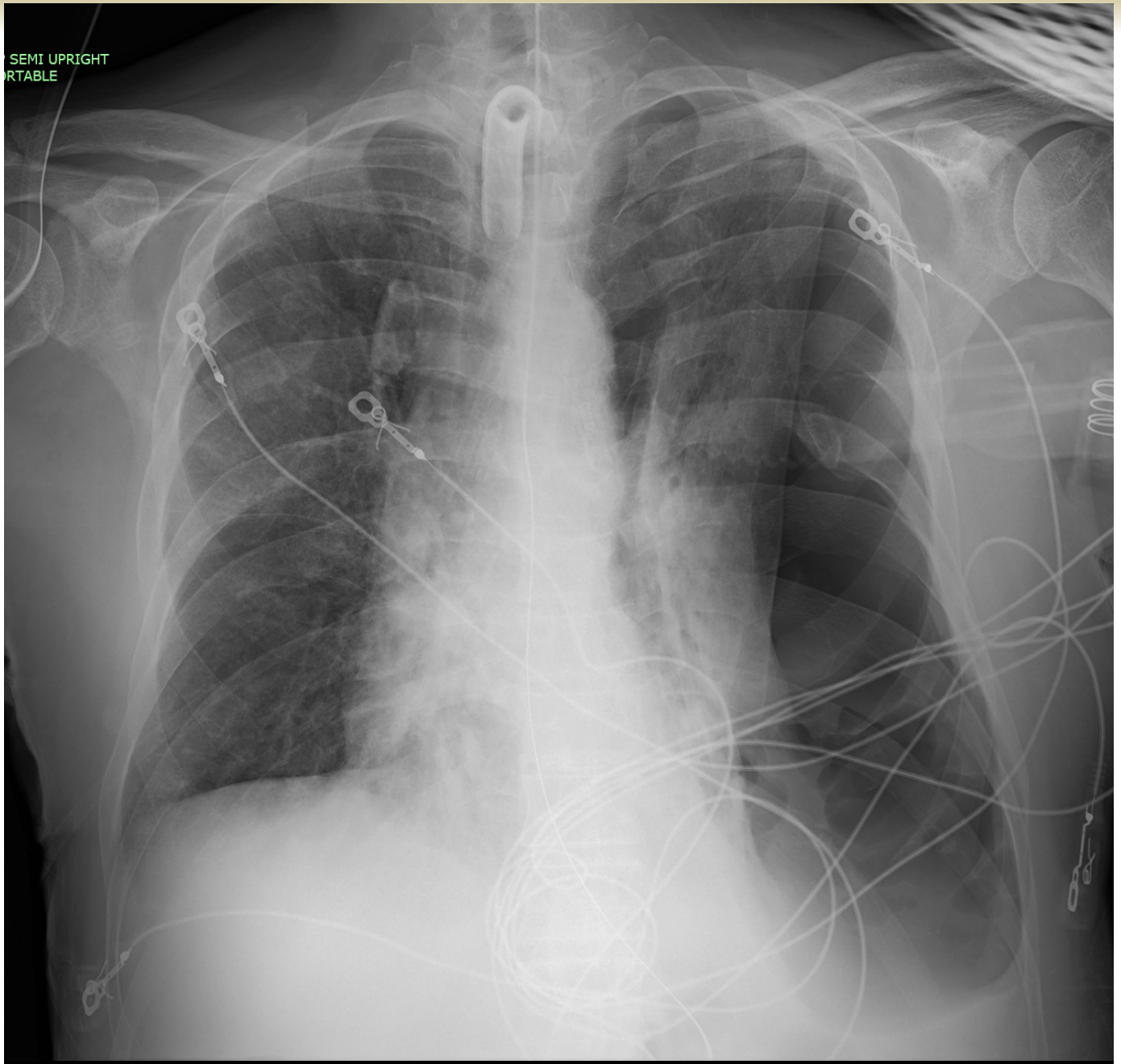


Case 2

A 23-year-old man is brought to the ED 25 minutes after being involved in a high-speed motor vehicle collision in which he was the restrained driver. He reports severe chest pain and mild dyspnea. His pulse is 93/min, respirations are 28/min, and blood pressure is 91/65 mm Hg. Pulse oximetry on room air shows an oxygen saturation of 88%.

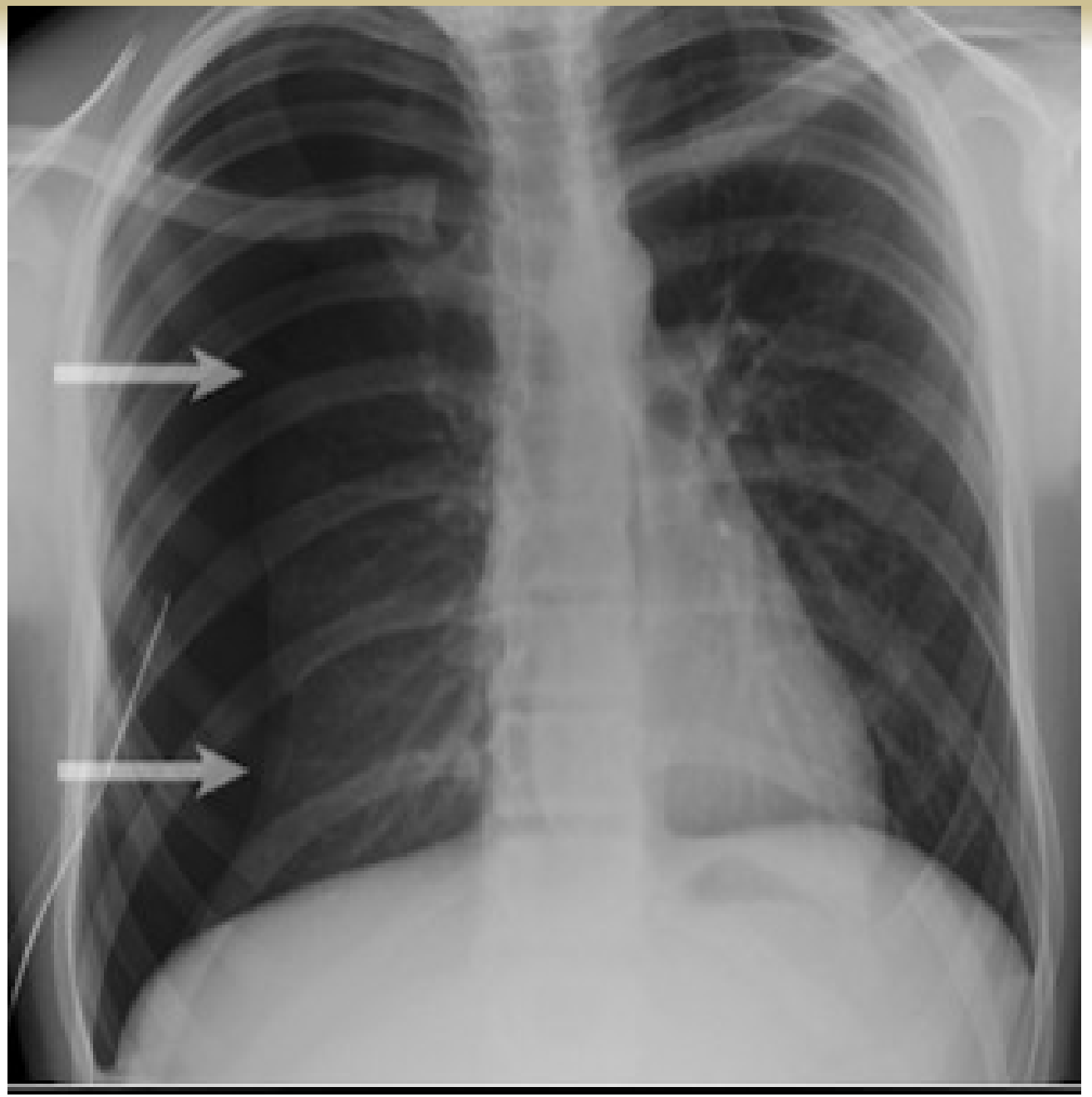
Physical Examination

He can move his extremities in response to commands. He opens his eyes spontaneously. Pupils are equal and reactive to light. Examination shows multiple bruises over the trunk and extremities. There is a 3-cm (1.2-in) wound at the left fifth intercostal space at the midclavicular line. There is jugular venous distention. Decreased breath sounds and hyperresonance on percussion are noted on the left.

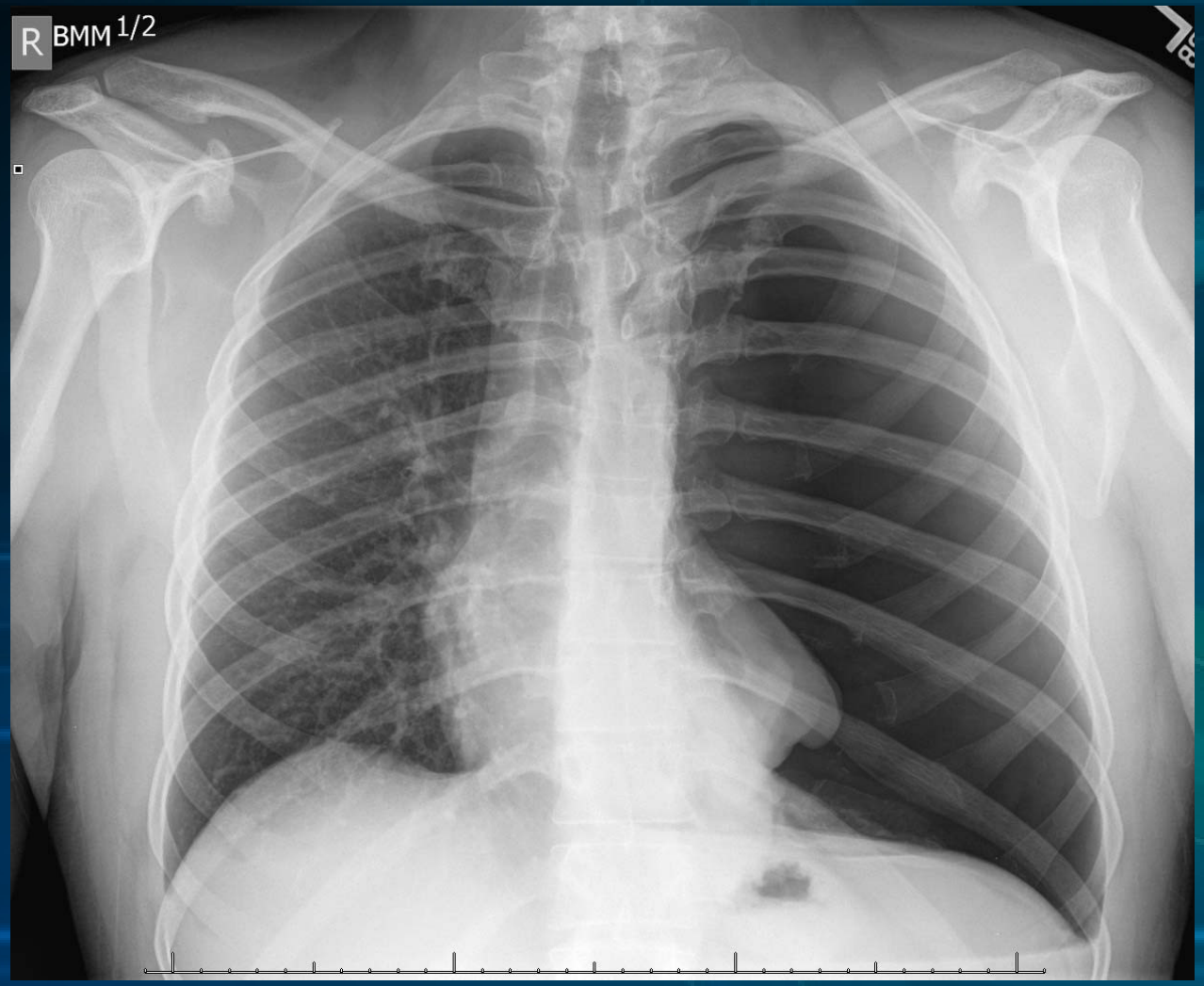

SEMI UPRIGHT
RTABLE

Case 2 - Pneumothorax

- Refers to the presence of air in the pleural space
- Post traumatic
- Spontaneous (primary vs secondary)
- Iatrogenic
- Simple vs Tension



Chest Radiography: Pneumothorax



Pneumothorax

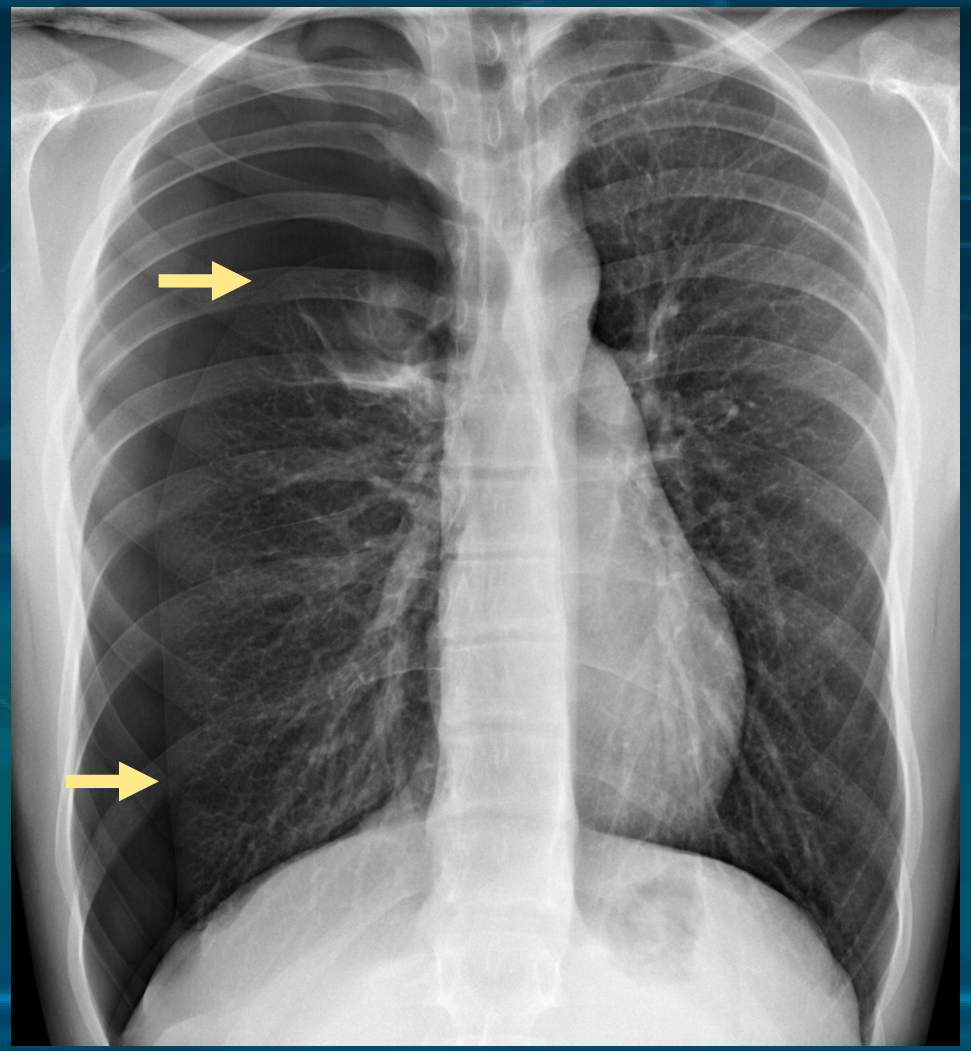
Normal lung demarcated from air-filled pleural space with absent markings

Chest Radiography: Pneumothorax

Chest Radiography: Pneumothorax

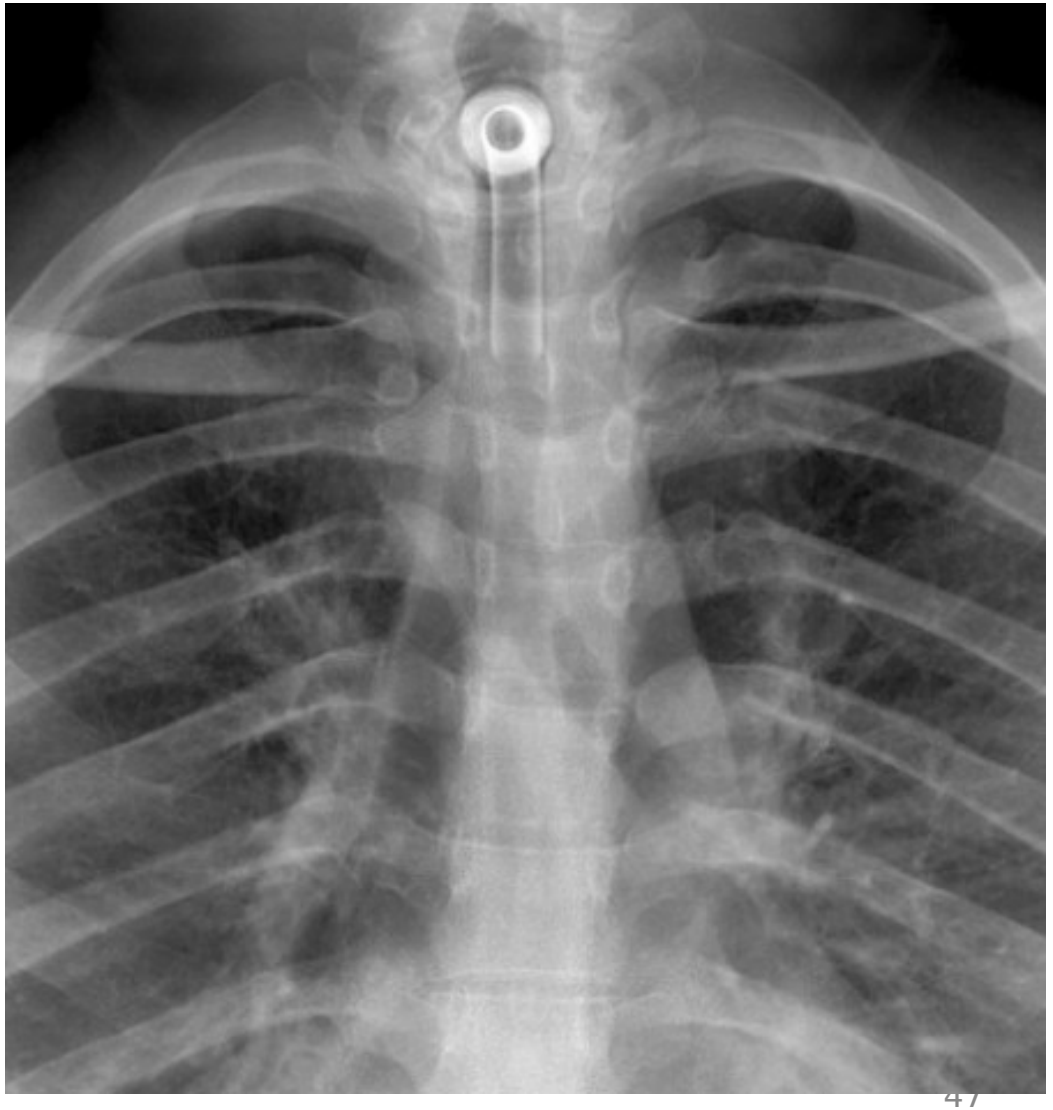
Pneumothorax

A pleural line demarcates the air-filled pleural space (with absent markings) from the collapsed lung

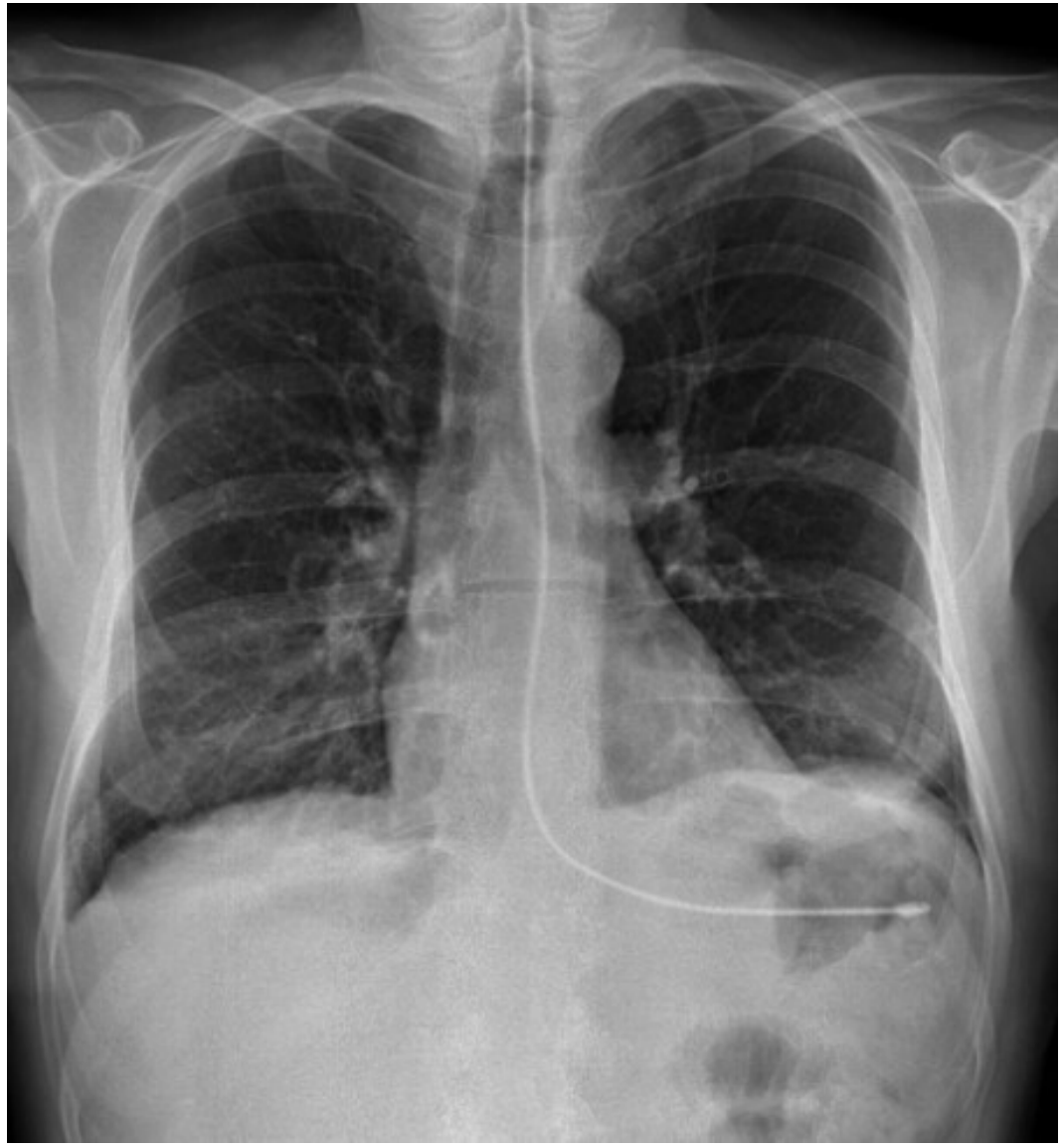


ET tube

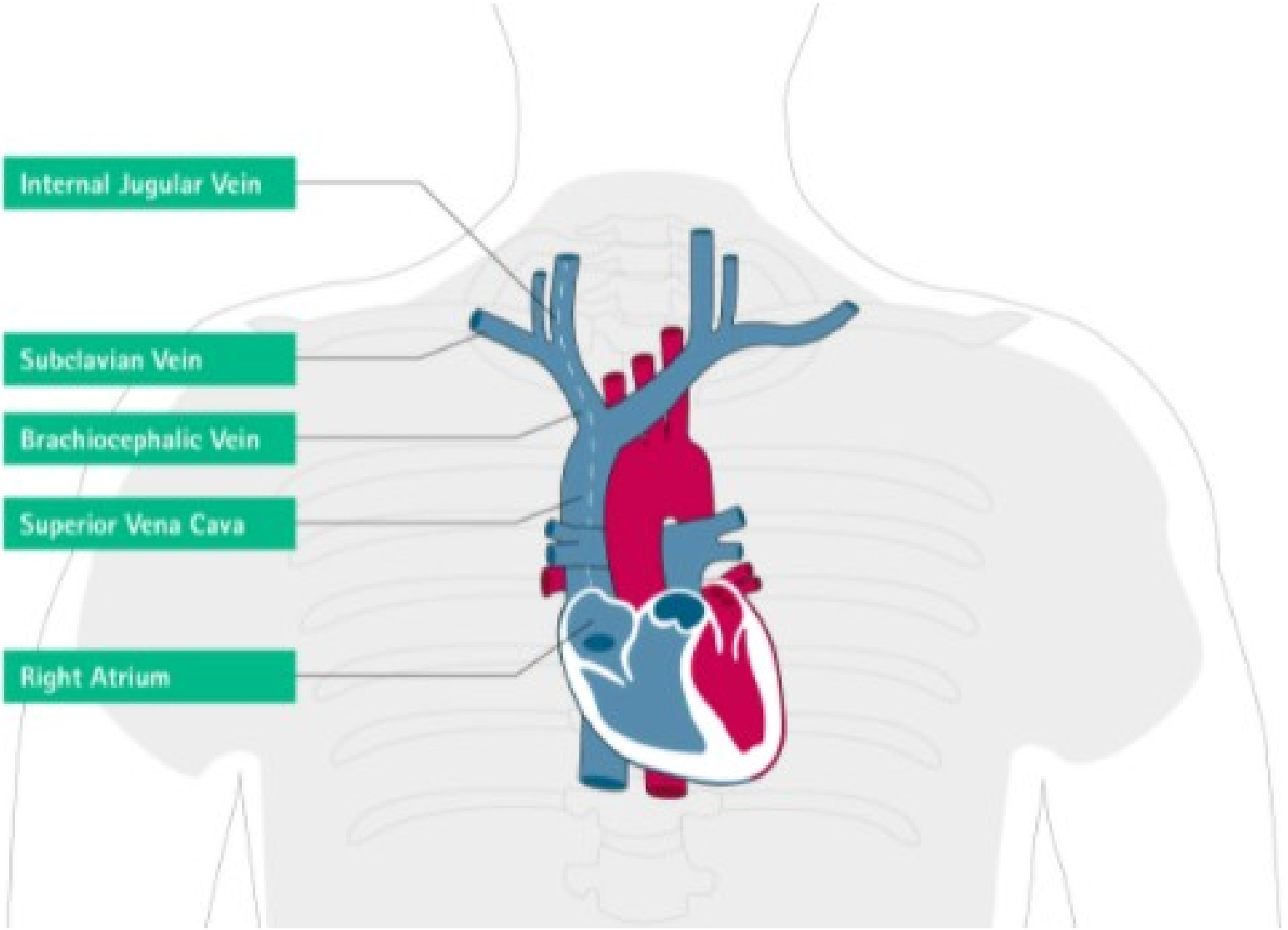
Tracheostomy tube



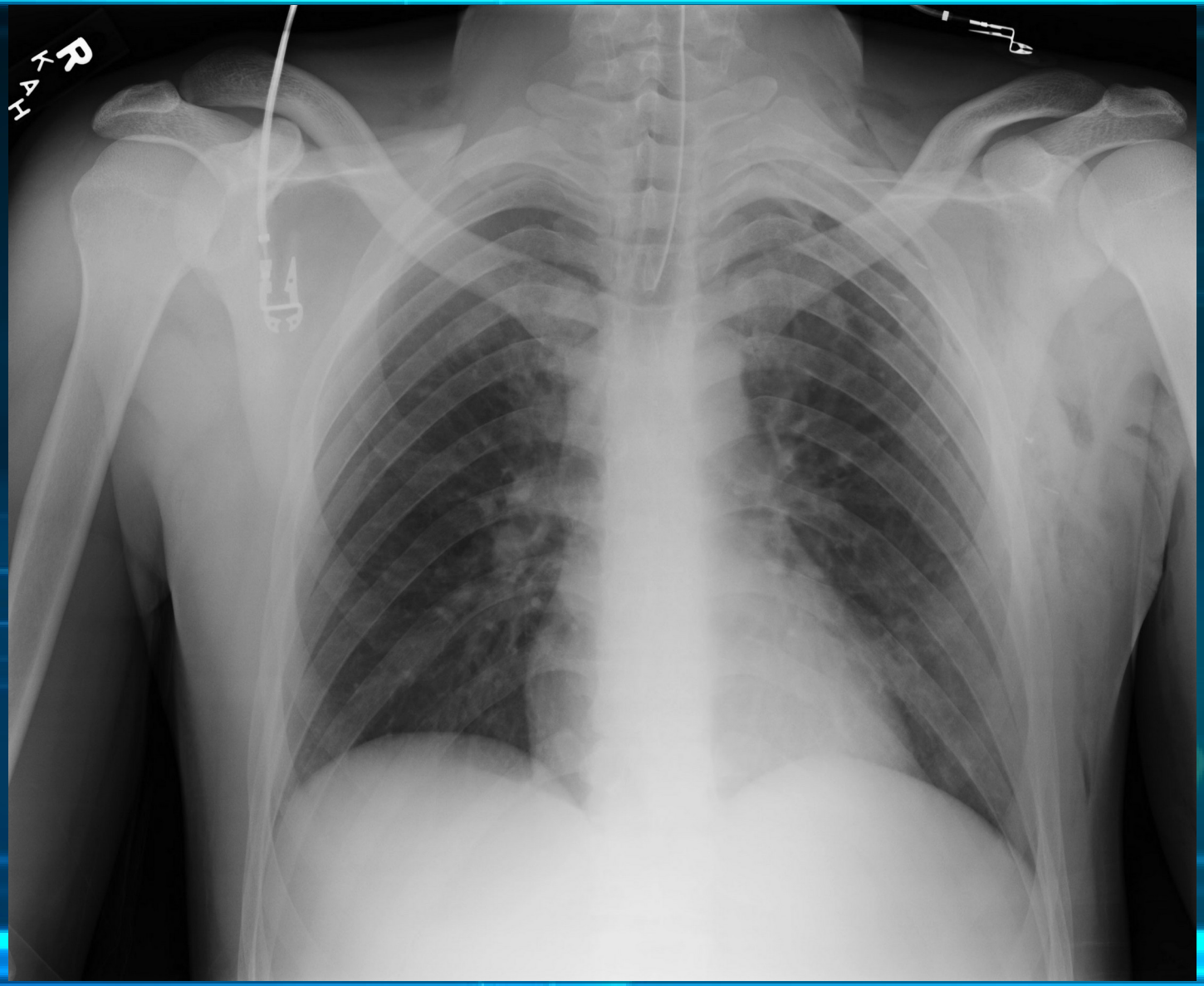
NG tube



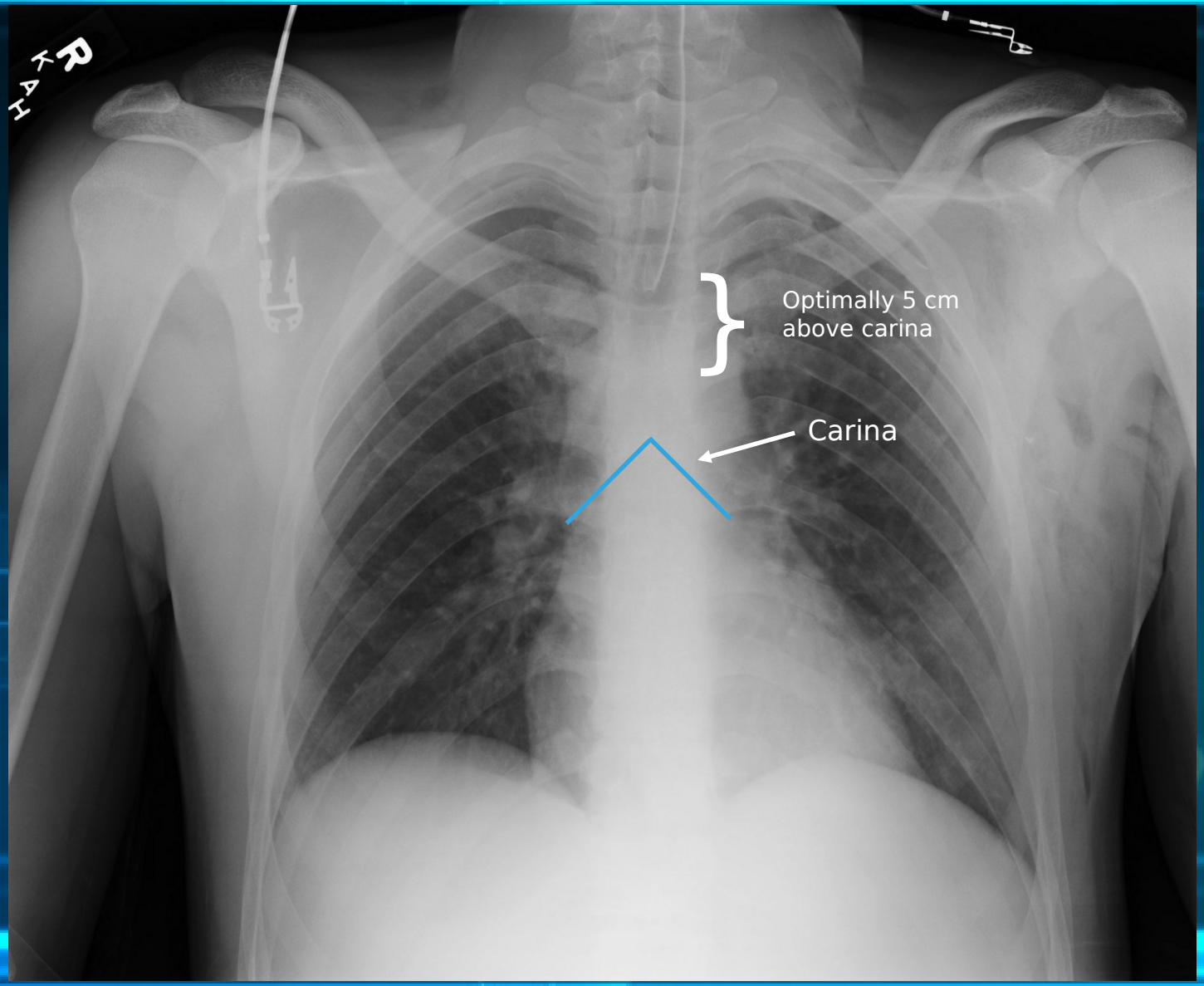
Central Venous Catheters



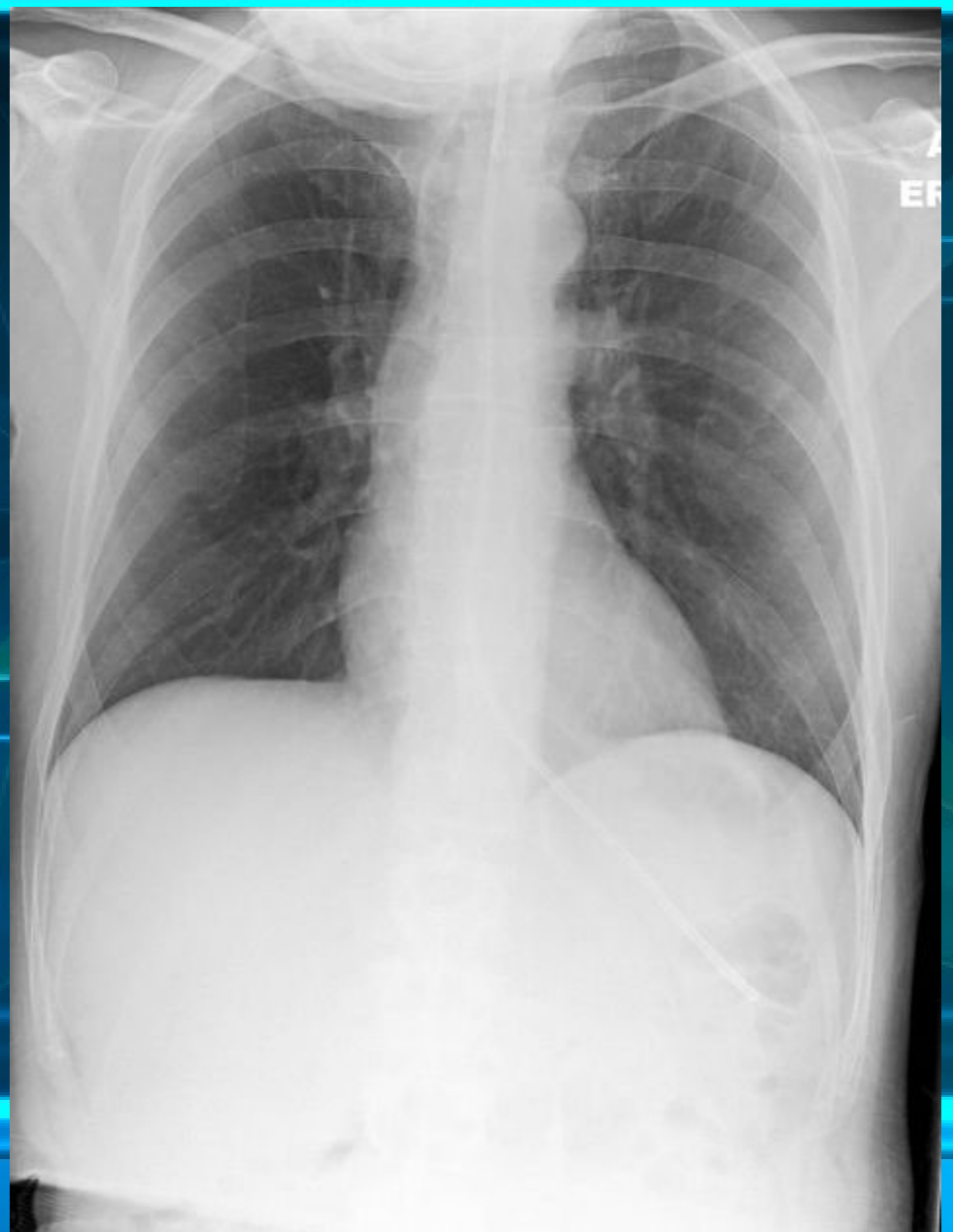
Lines and Tubes:



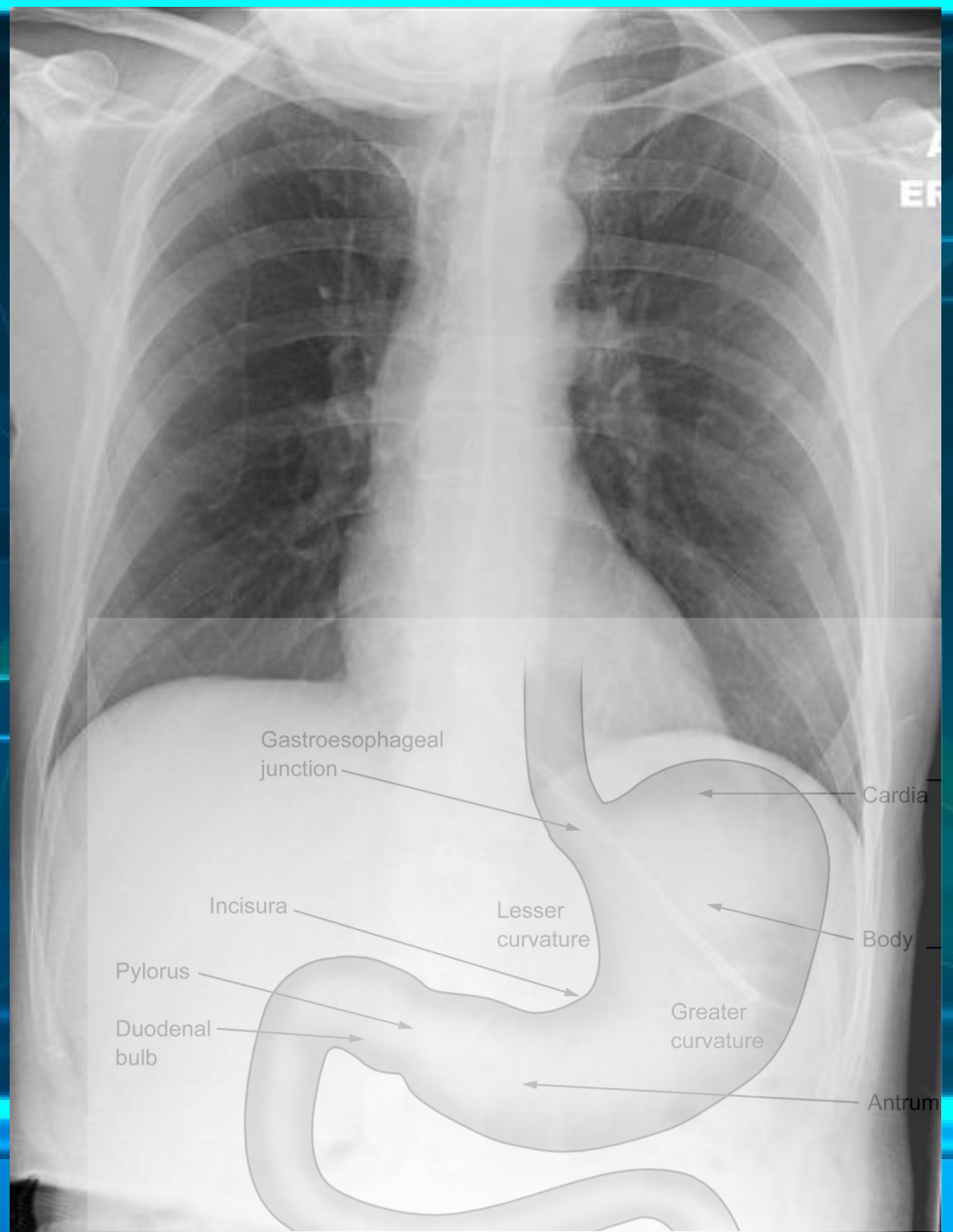
Lines and Tubes: Endotracheal tube



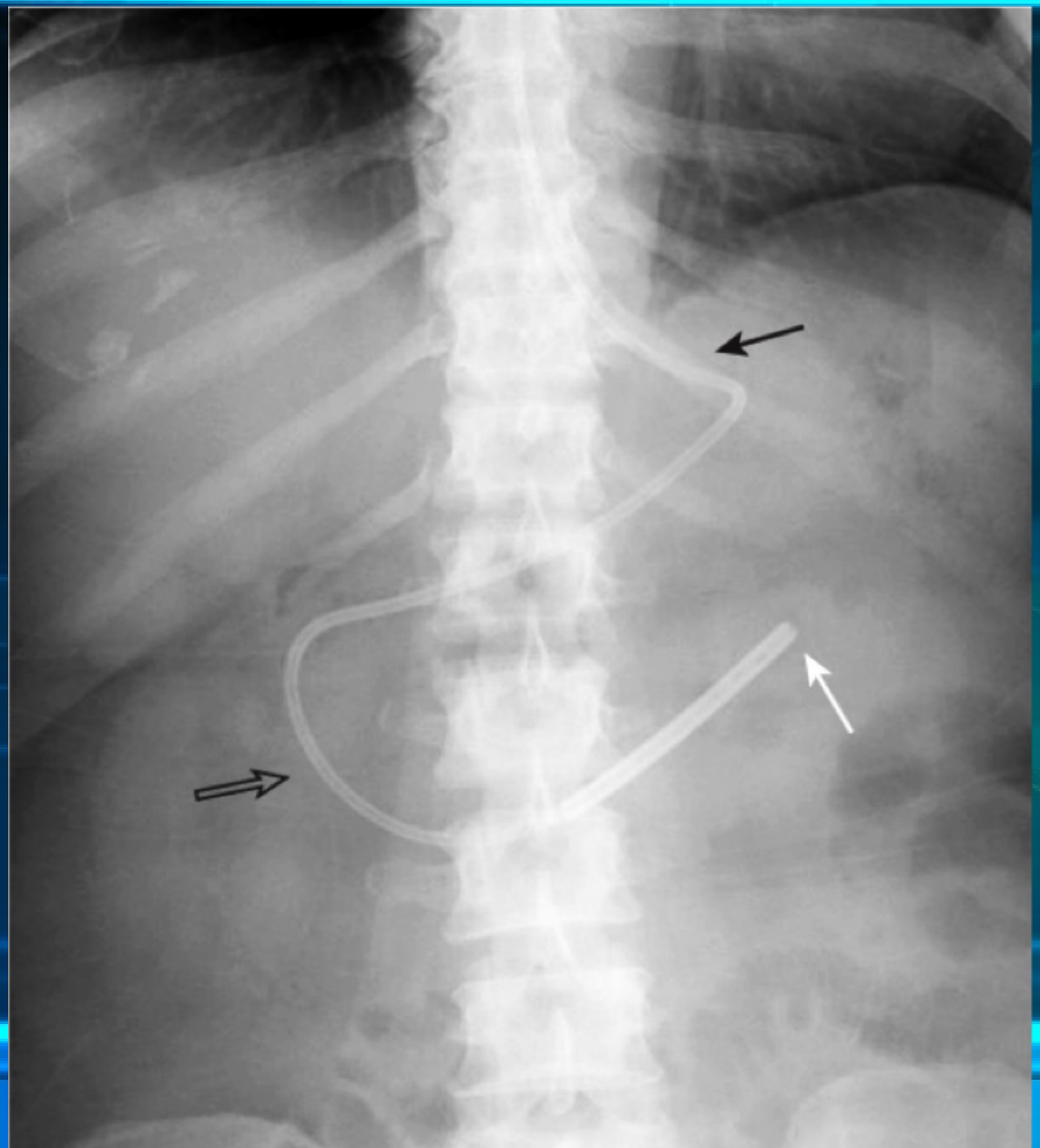
Lines and Tubes:



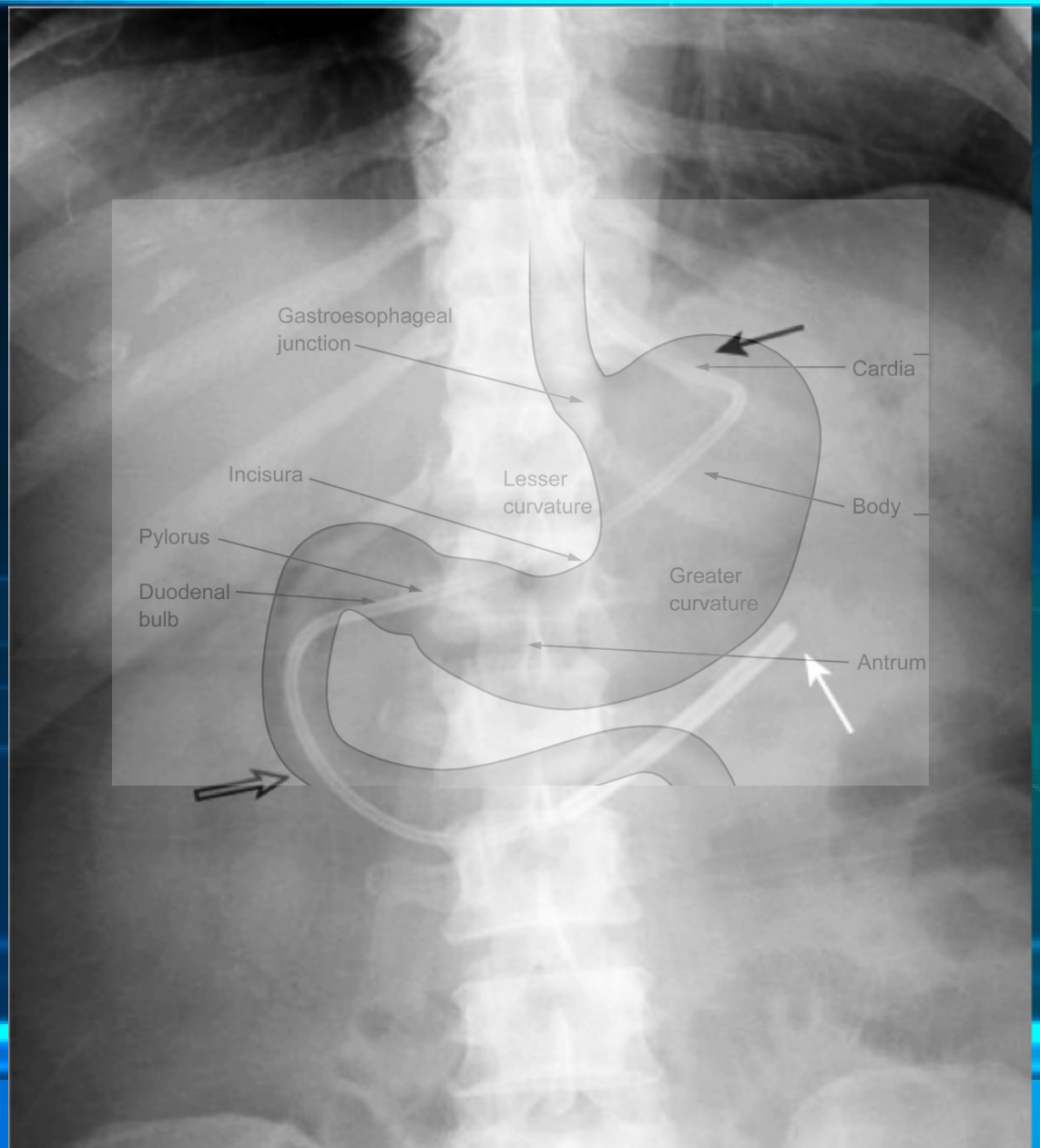
Lines and Tubes: Nasogastric tube



Lines and Tubes:



Lines and Tubes: Feeding tube



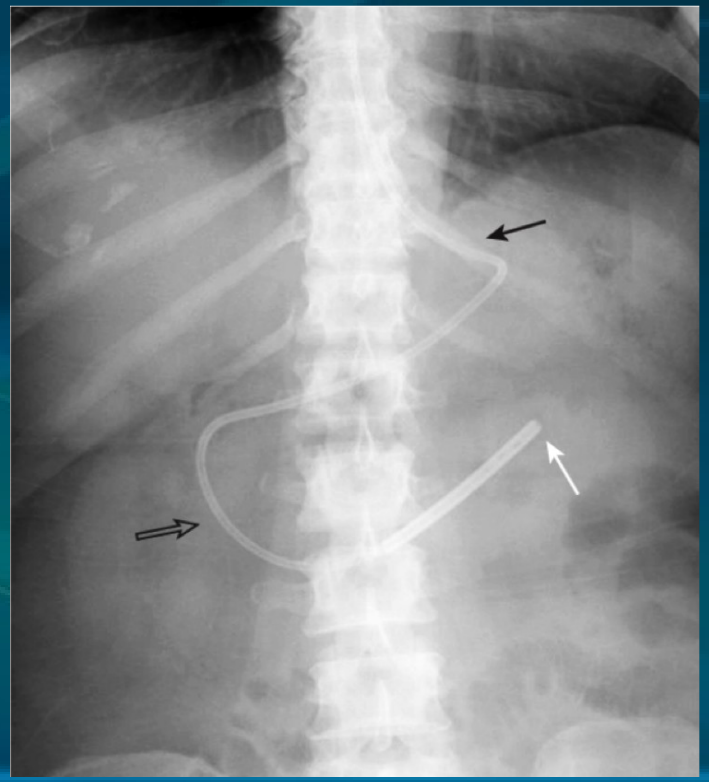
Optimal placement of feeding tube duodenal-jejunal junction

The tube crosses midline twice

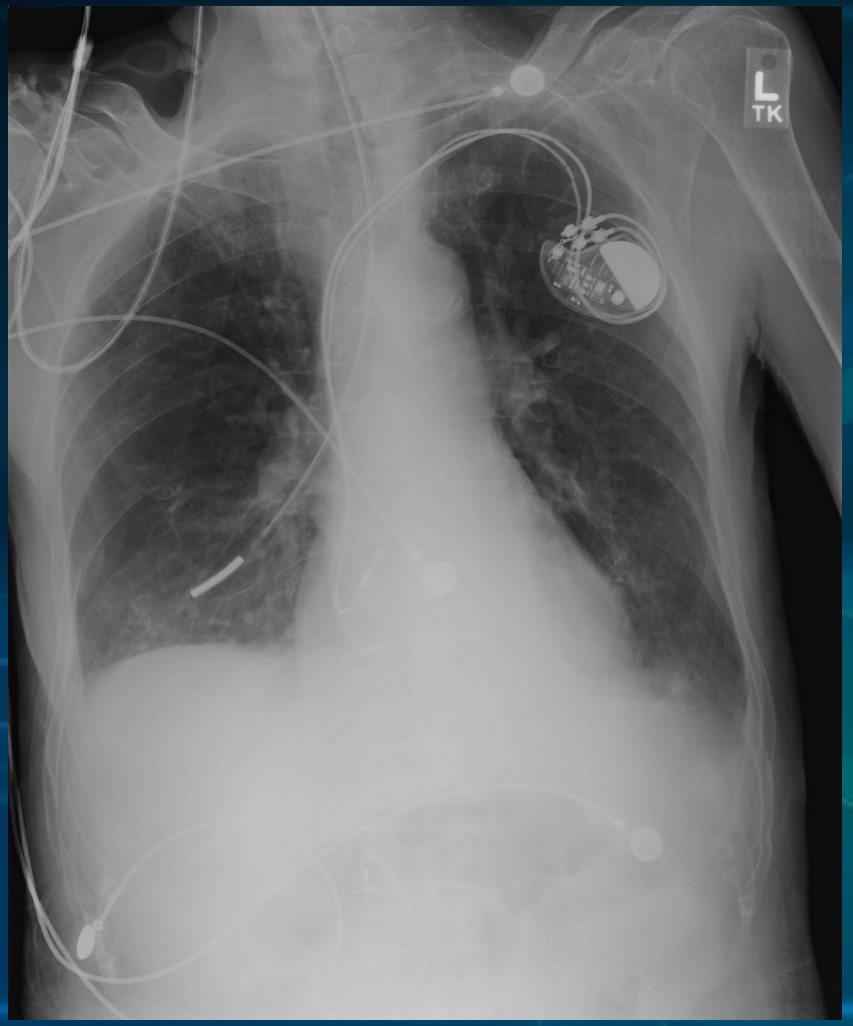
Lines and Tubes: NG tube / Feeding tube

Nasogastric tube

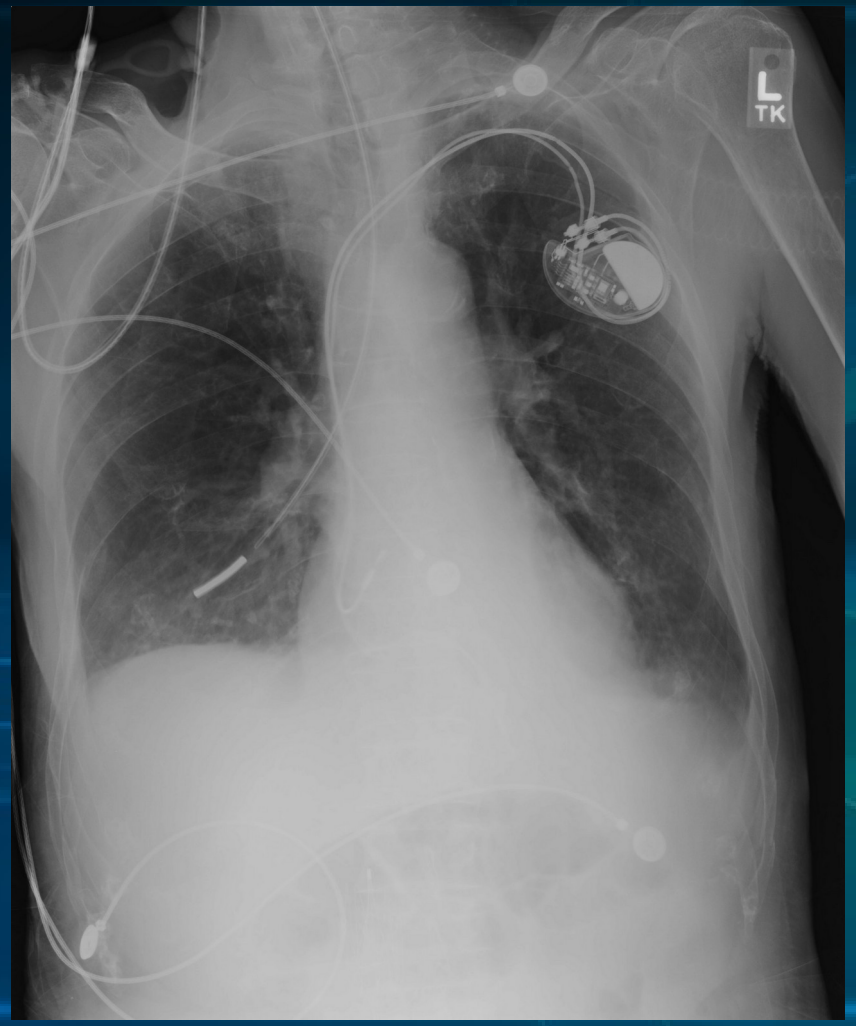
Feeding tube



Lines and Tubes: NG tube / Feeding tube

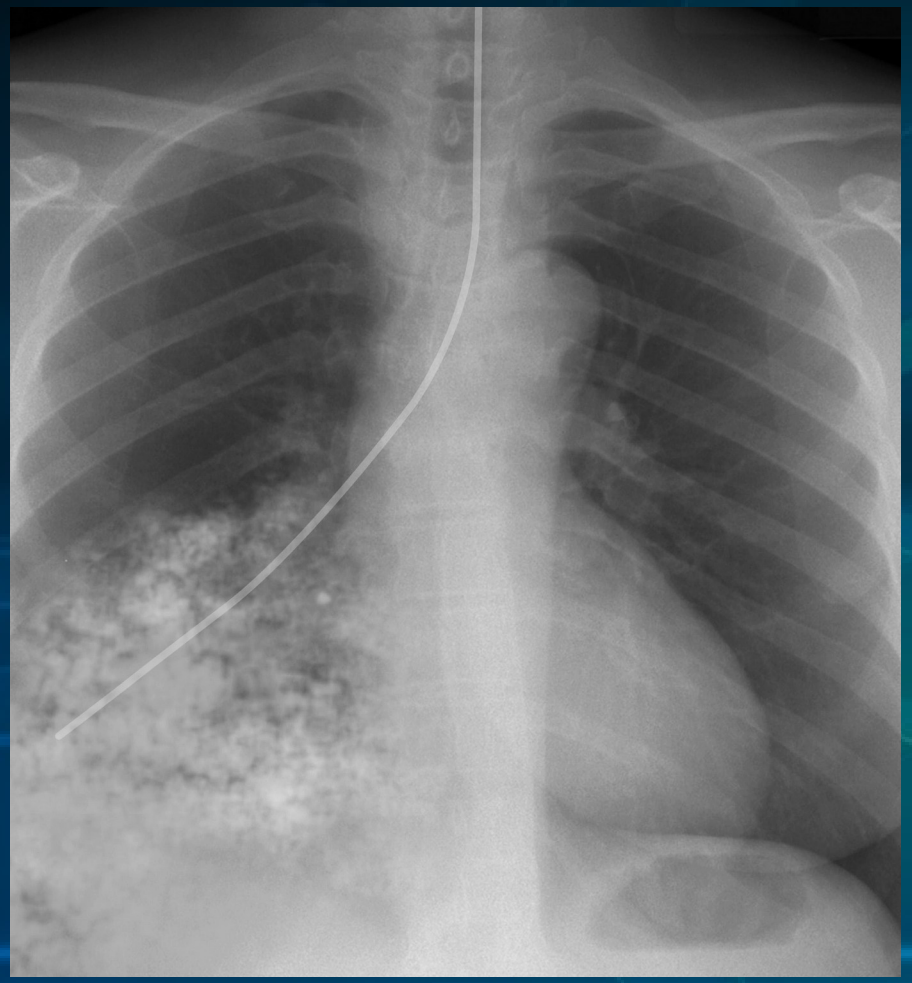


Lines and Tubes: NG tube / Feeding tube



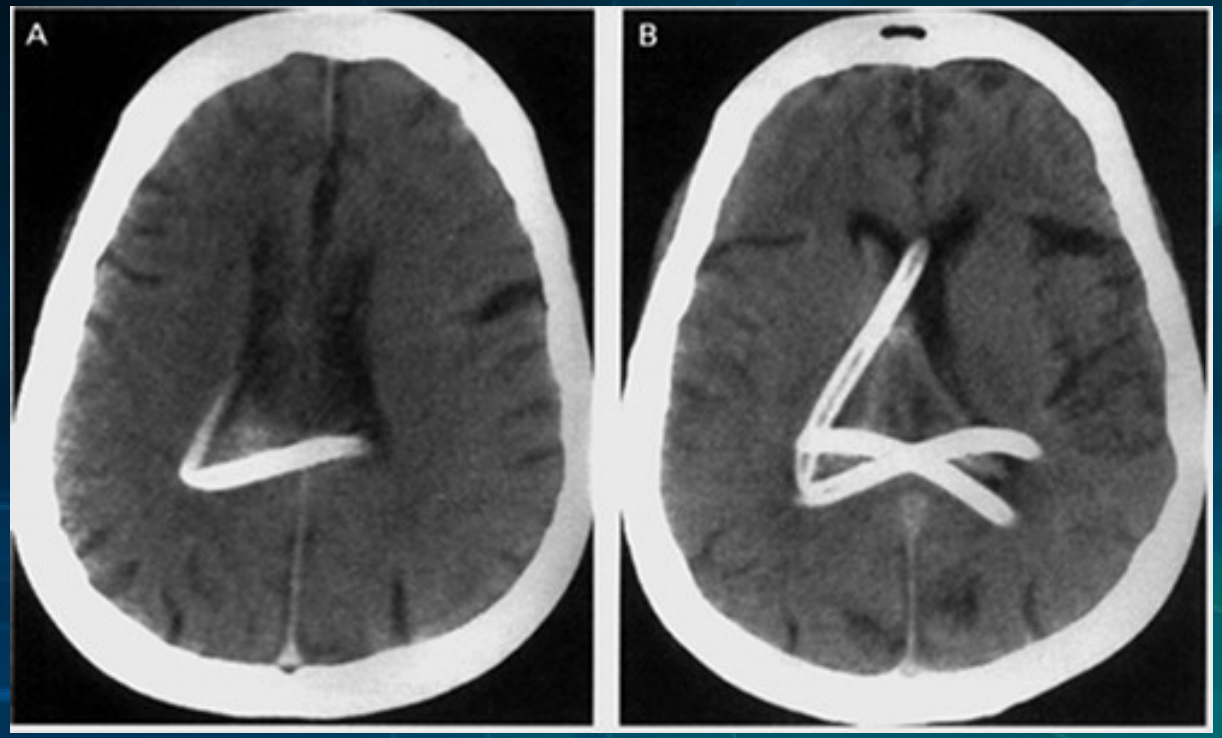
Feeding tube misplaced in right bronchial tree

Lines and Tubes: NG tube / Feeding tube

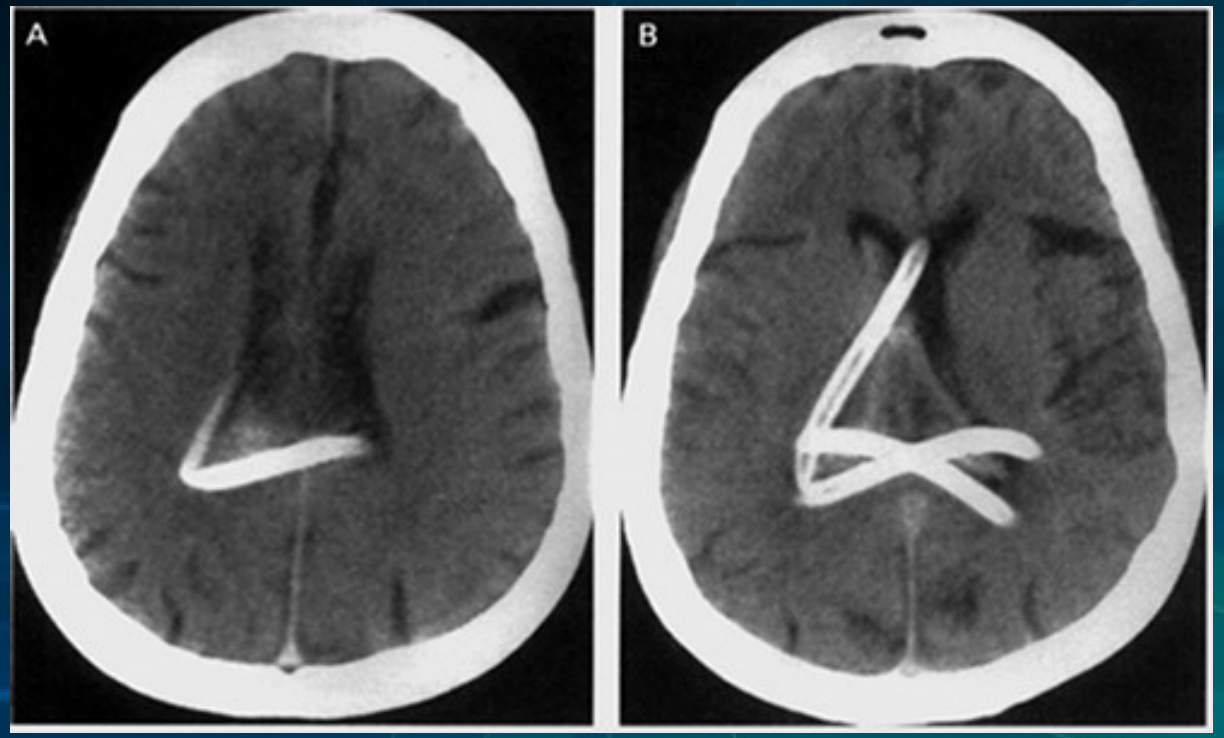


Feeding tube misplaced in right bronchial tree

Lines and Tubes: NG tube / Feeding tube

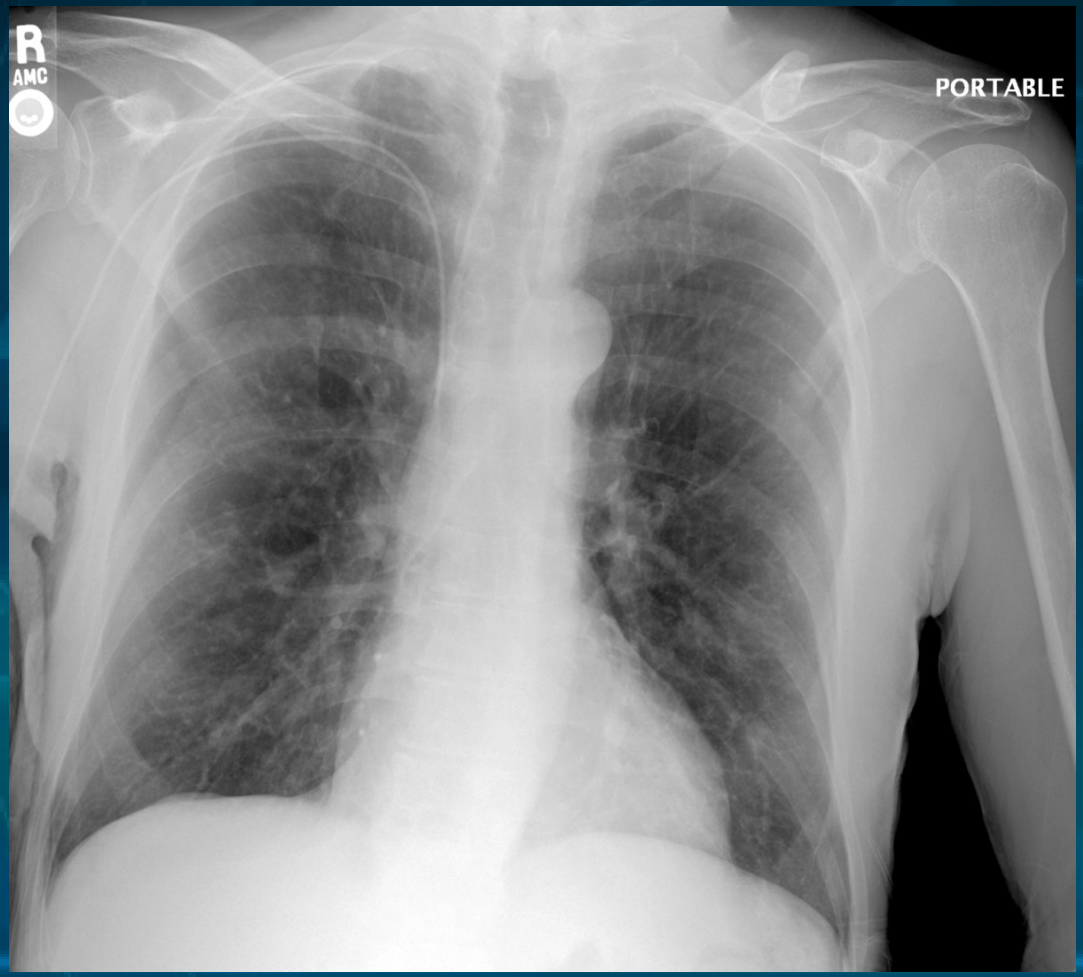


Lines and Tubes: NG tube / Feeding tube



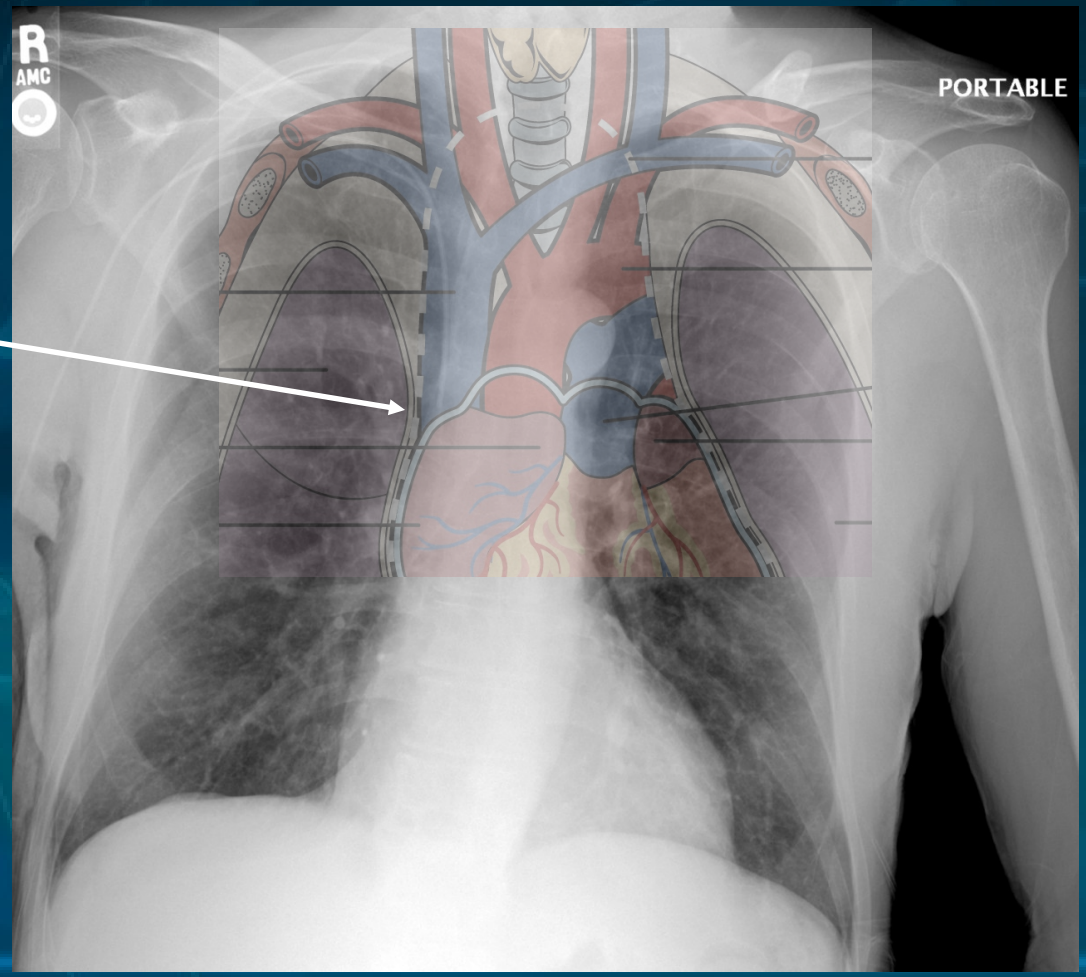
Feeding tube in brain, traversing the cribiform plate

Lines and Tubes: PICC



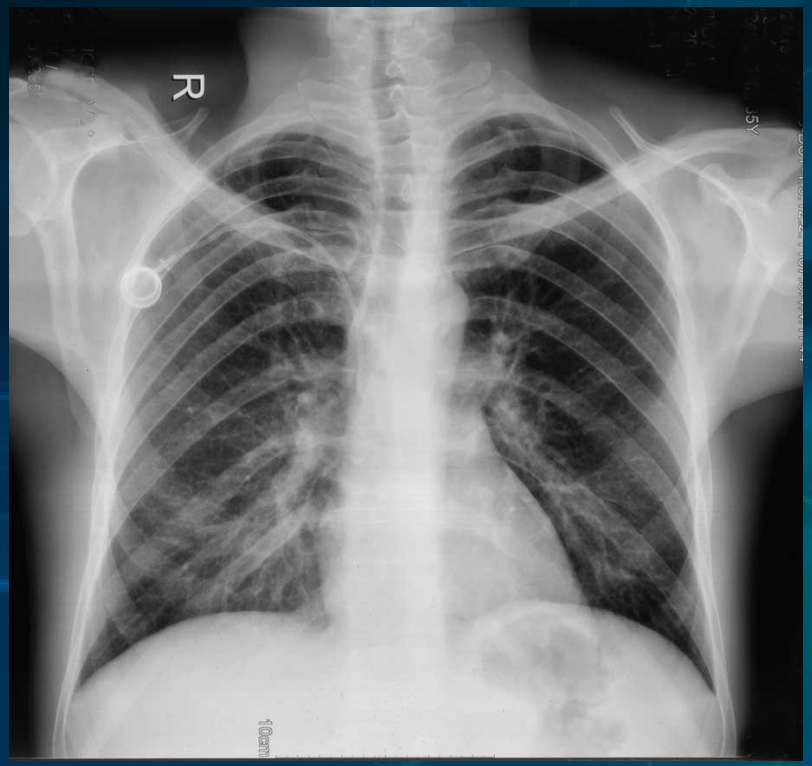
Lines and Tubes: PICC

Optimal placement at junction of SVC and right atrium

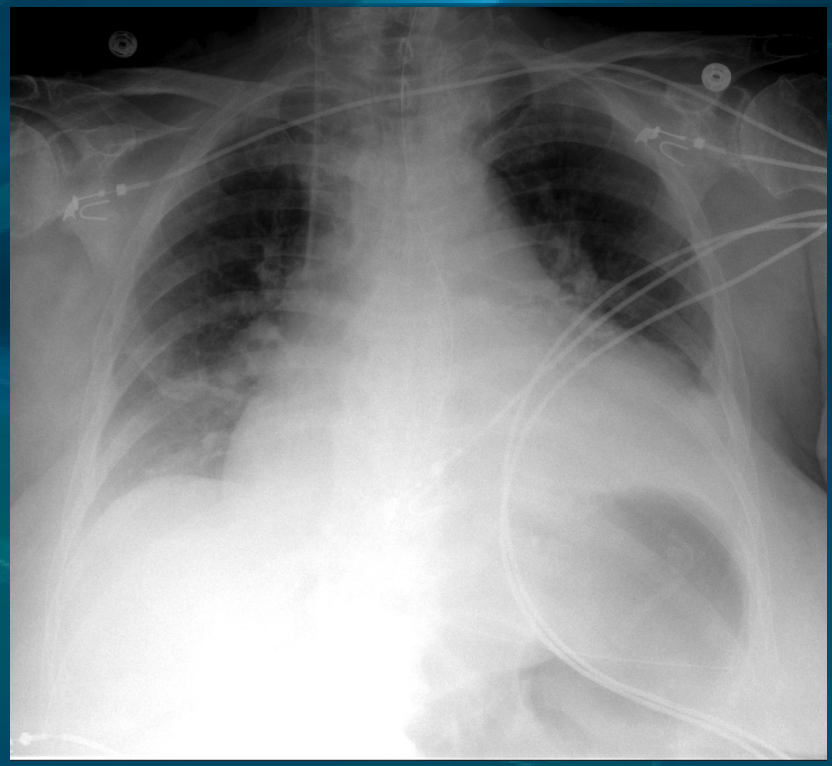


Lines and Tubes: Central lines

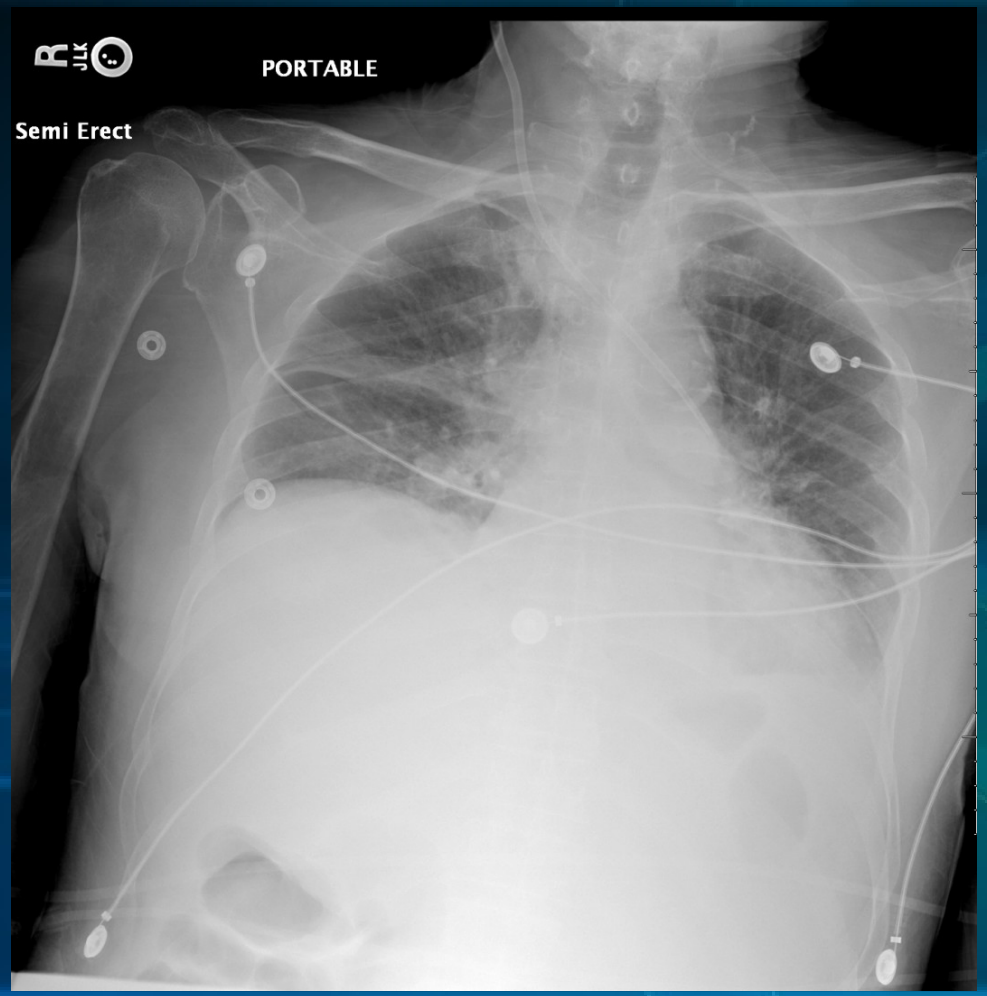
Subclavian port catheter



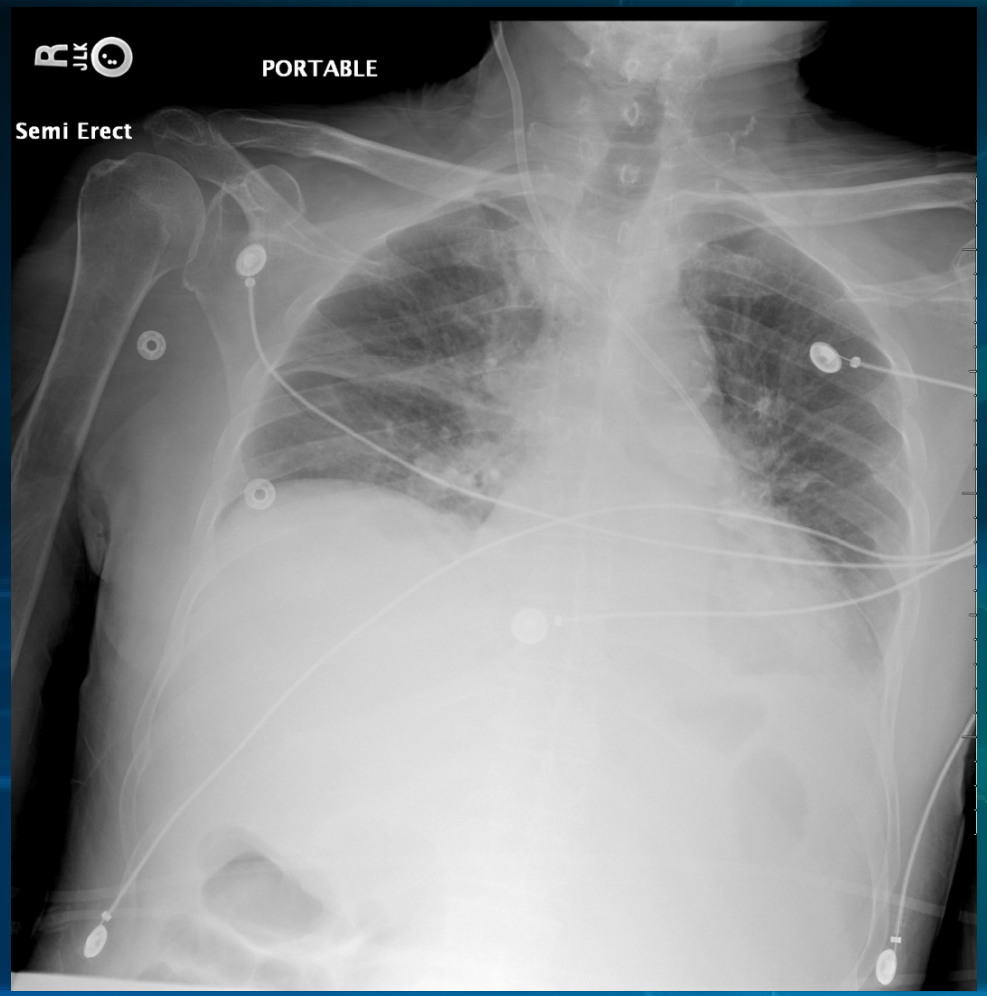
Internal jugular catheter



Lines and Tubes: Central lines



Lines and Tubes: Central lines



Right IJ catheter misplaced arterially, positioned within aorta

Case 3

A 65-year-old man comes to the physician because of a 1-month history of increasing shortness of breath. He has been using two pillows at night but frequently wakes up feeling as if he is choking. He has a history of HTN, HLD, nonalcoholic fatty liver disease, and myocardial infarction that developed 10 years. Current medications include metoprolol, lisinopril, ethacrynic acid, eplerenone, and aspirin. He drinks one beer daily. He has a 30-pack-year smoking history. He is allergic to sulfonamides. His temperature is 37.1°C (98.8°F), pulse is 103/min

Physical Examination

Physical examination shows 3+ bilateral pitting pedal edema. There is jugular venous distention. Crackles are heard over the lower lung fields bilaterally. Cardiac examination shows an S_3 gallop.

The point of maximal impulse is palpated 2 cm to the left of the midclavicular line at the 6th intercostal space. The abdomen is soft and nontender.

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Case 3 - Congestive Heart Failure

- Stage I (PCWP 13-18)

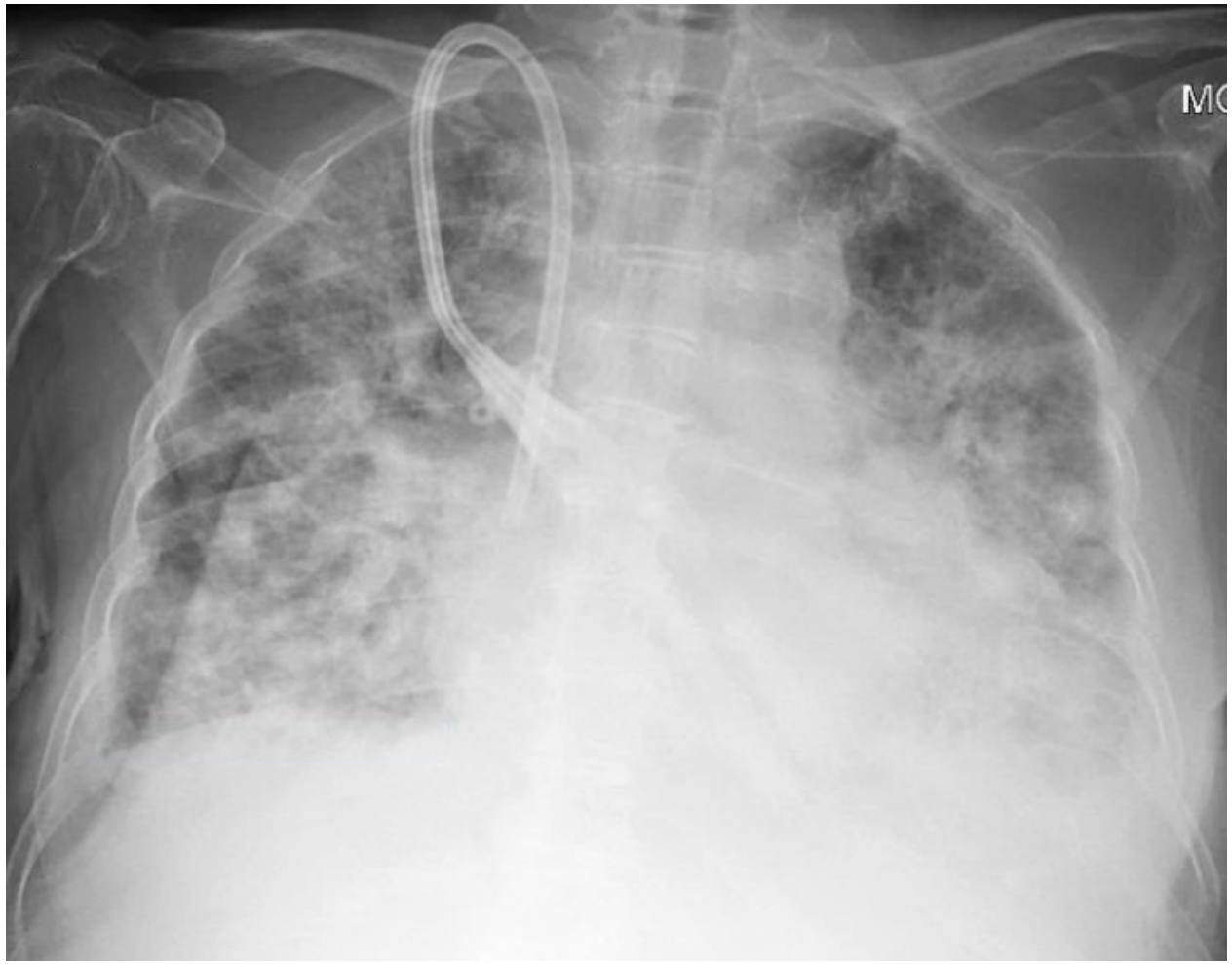
  CMG and Redistribution

- Stage II (PCWP 18-25)

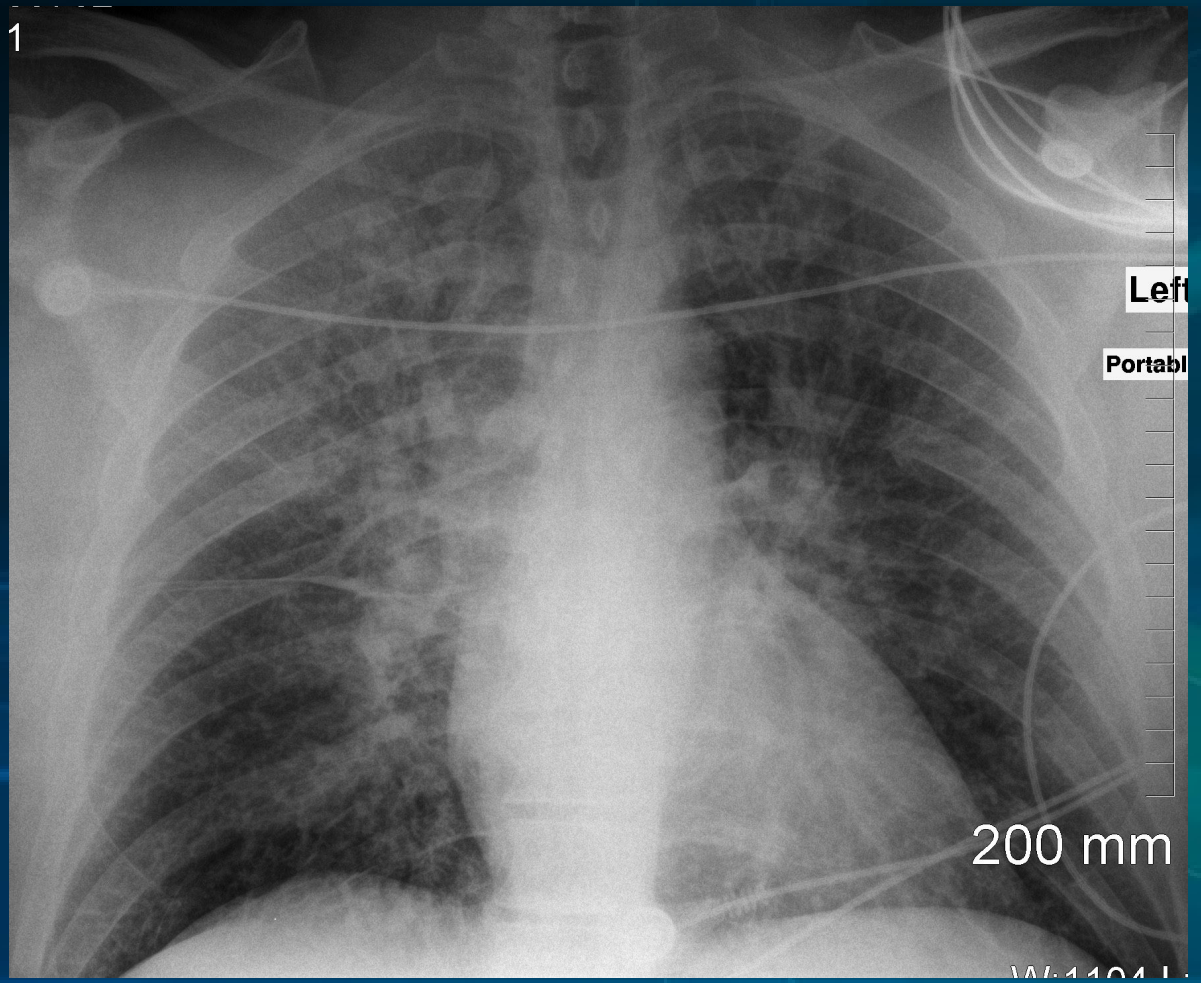
  Interstitial Edema including Kerley B lines, thickened fissures and Peribronchial Cuffing

- Stage III

  Alveolar Edema including Airspace disease and pleural effusions



Chest Radiography: Fluid overload

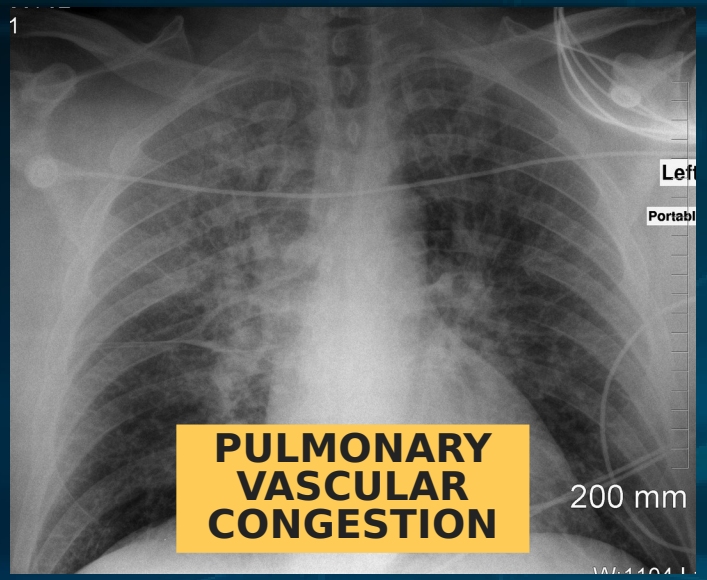


Pulmonary vascular congestion

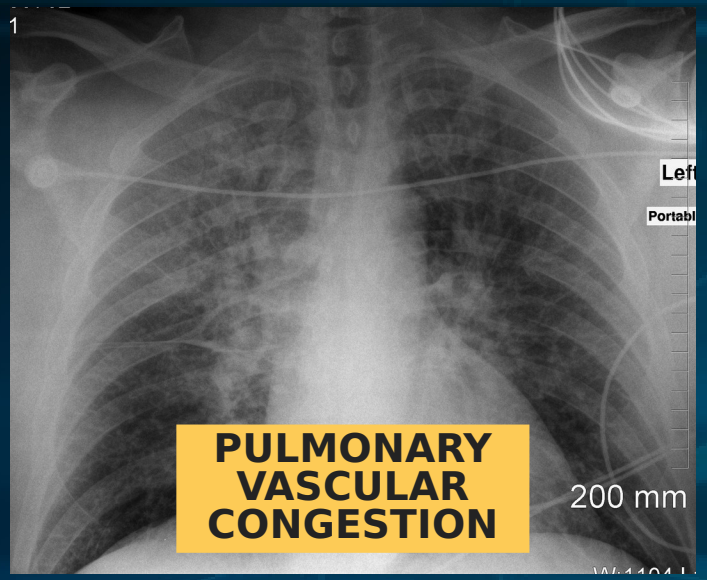
Normally, pulmonary vessels taper, and should not be readily visible peripherally

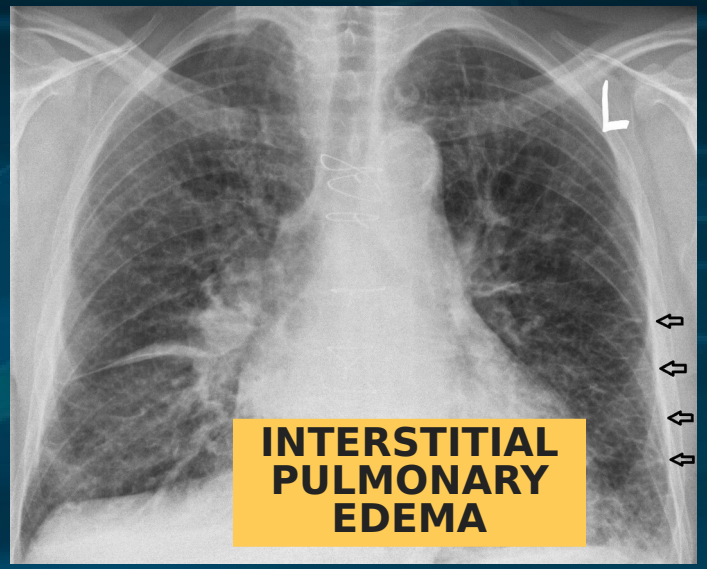
Congested vessels are larger, and are visible to the periphery of the lung

Chest Radiography: Fluid overload

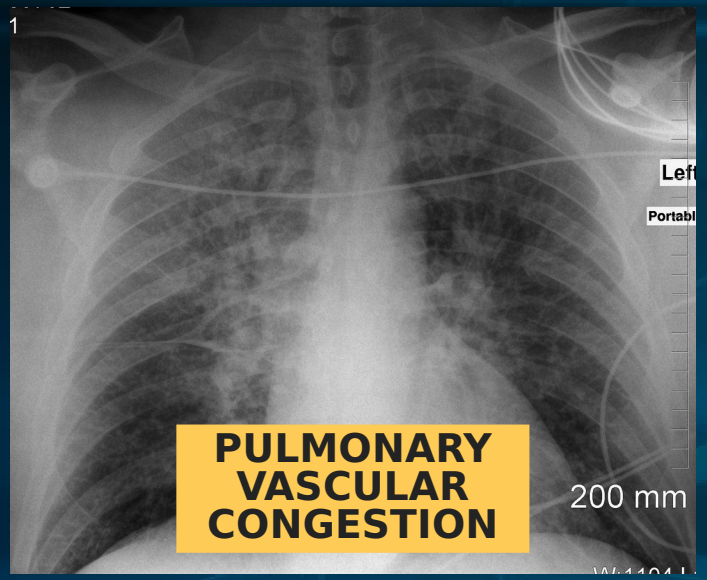


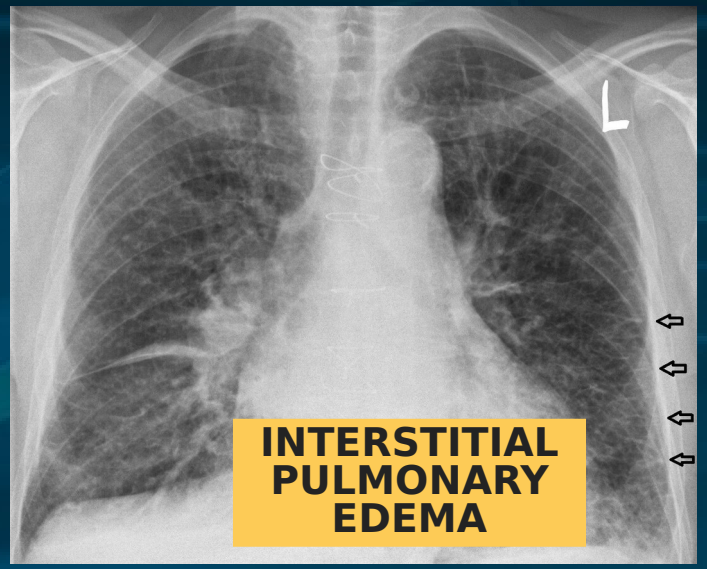
Chest Radiography: Fluid overload

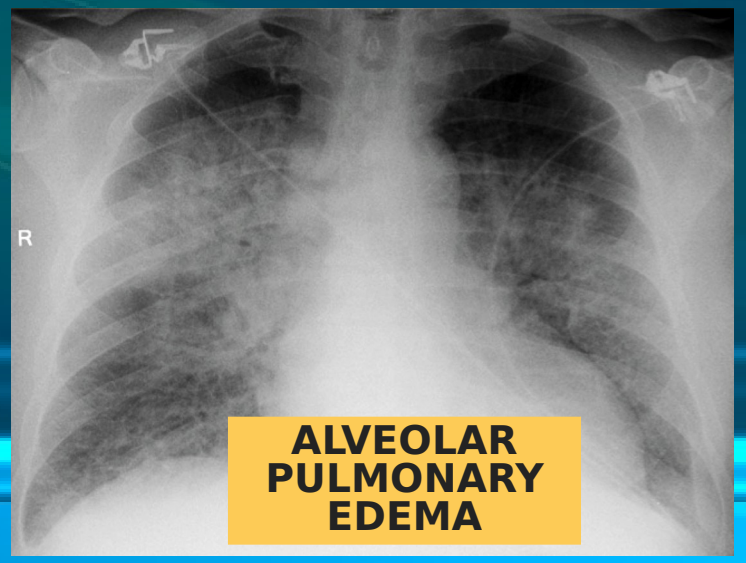




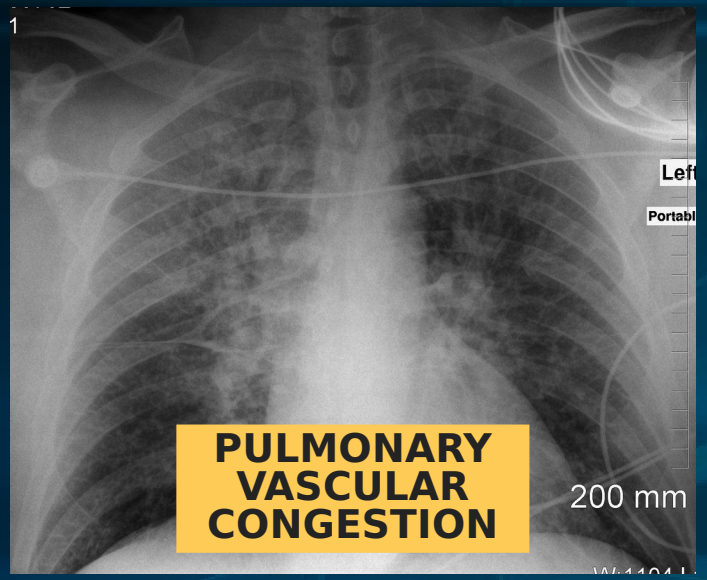
Chest Radiography: Fluid overload

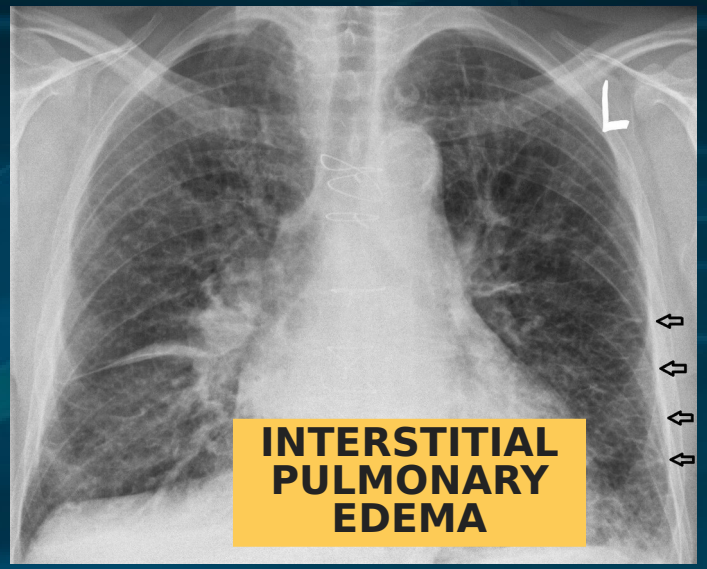


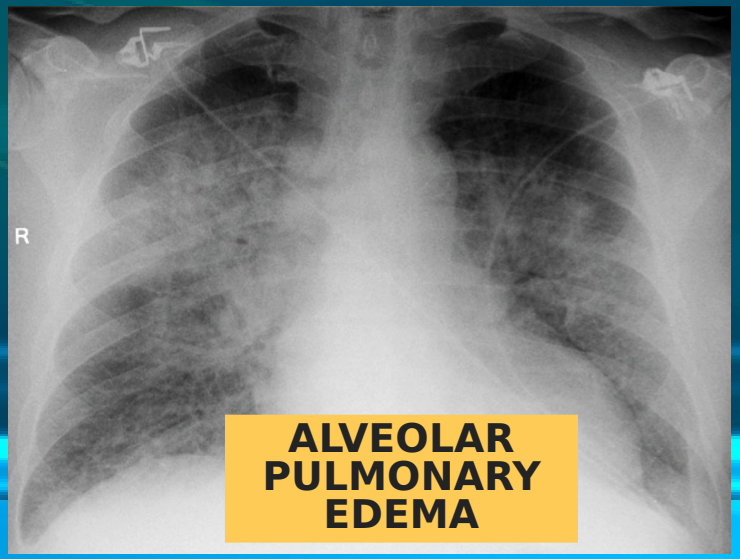


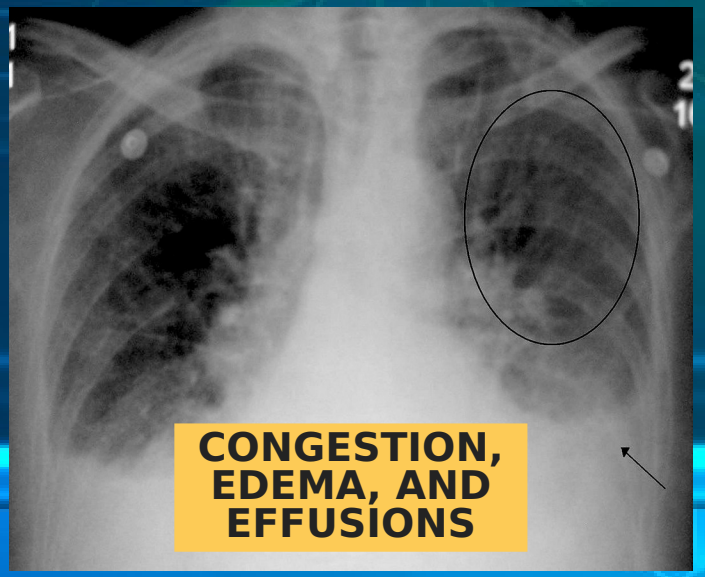


Chest Radiography: Fluid overload





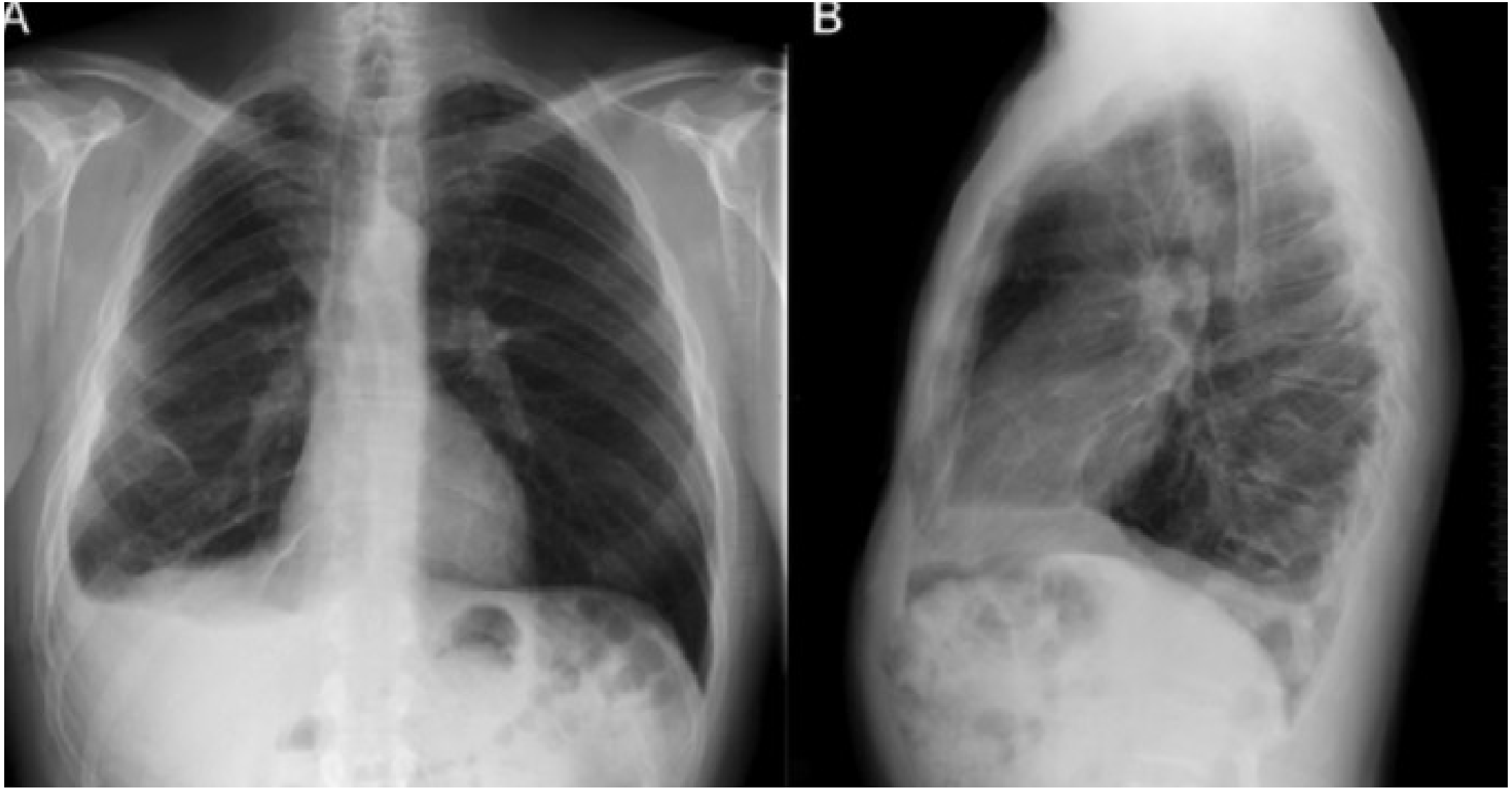




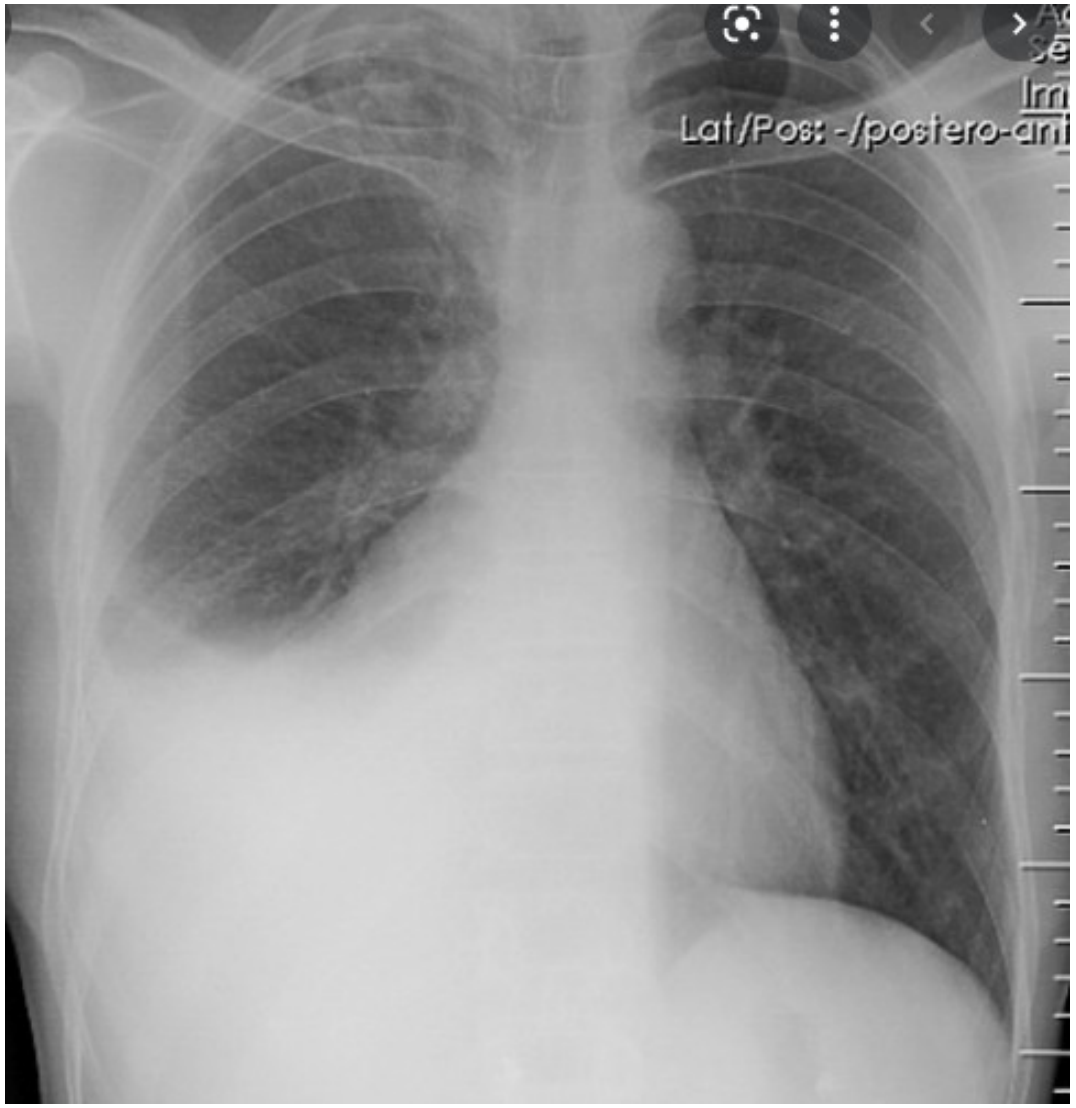
Pleural Effusions

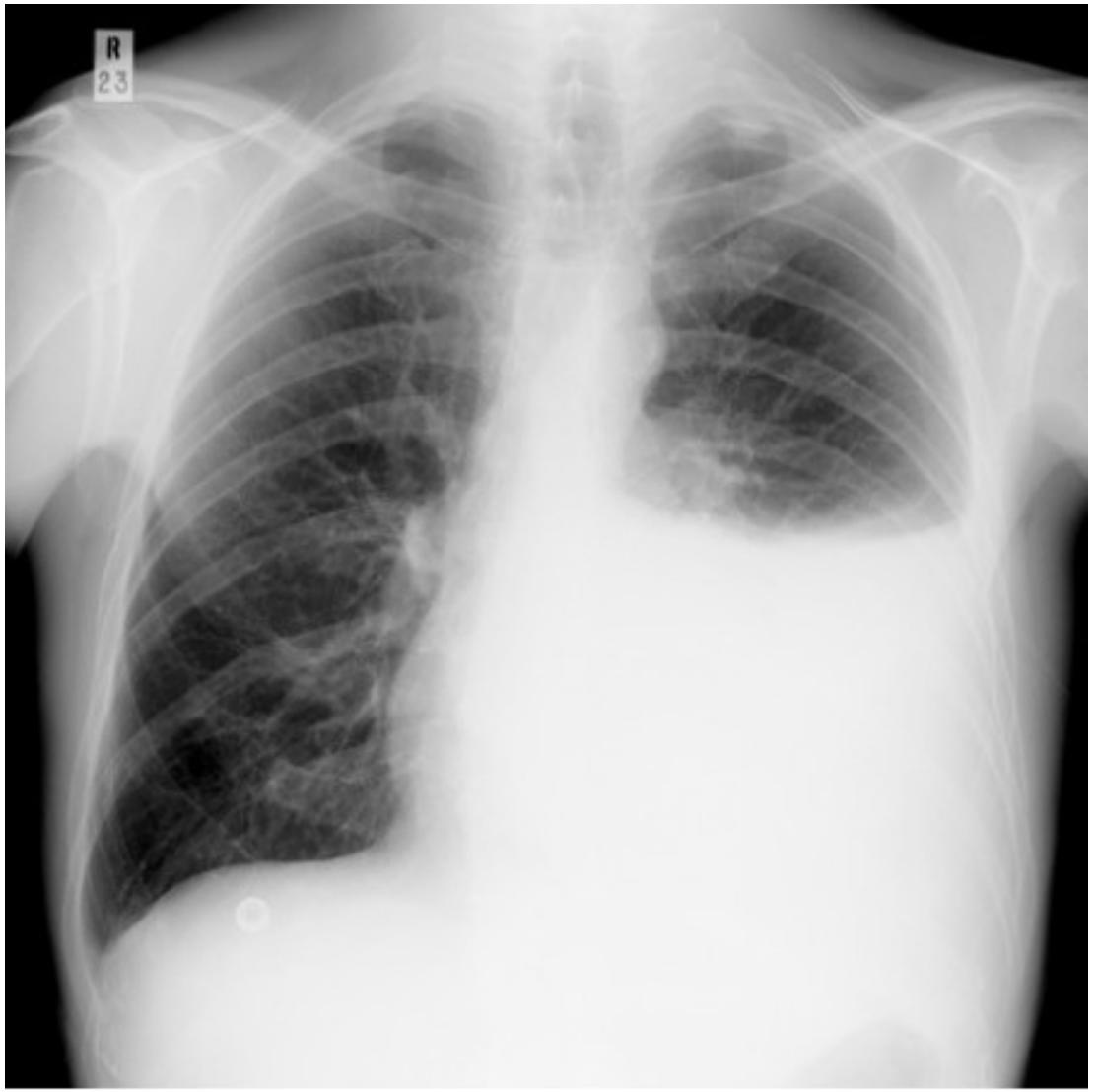
- Most commonly assessed with Chest X-ray
- Lateral is more sensitive, can detect 75cc
- Upright Frontal can detect 175cc
- Lateral decubitus can detect 20-30 cc

Pleural Effusions



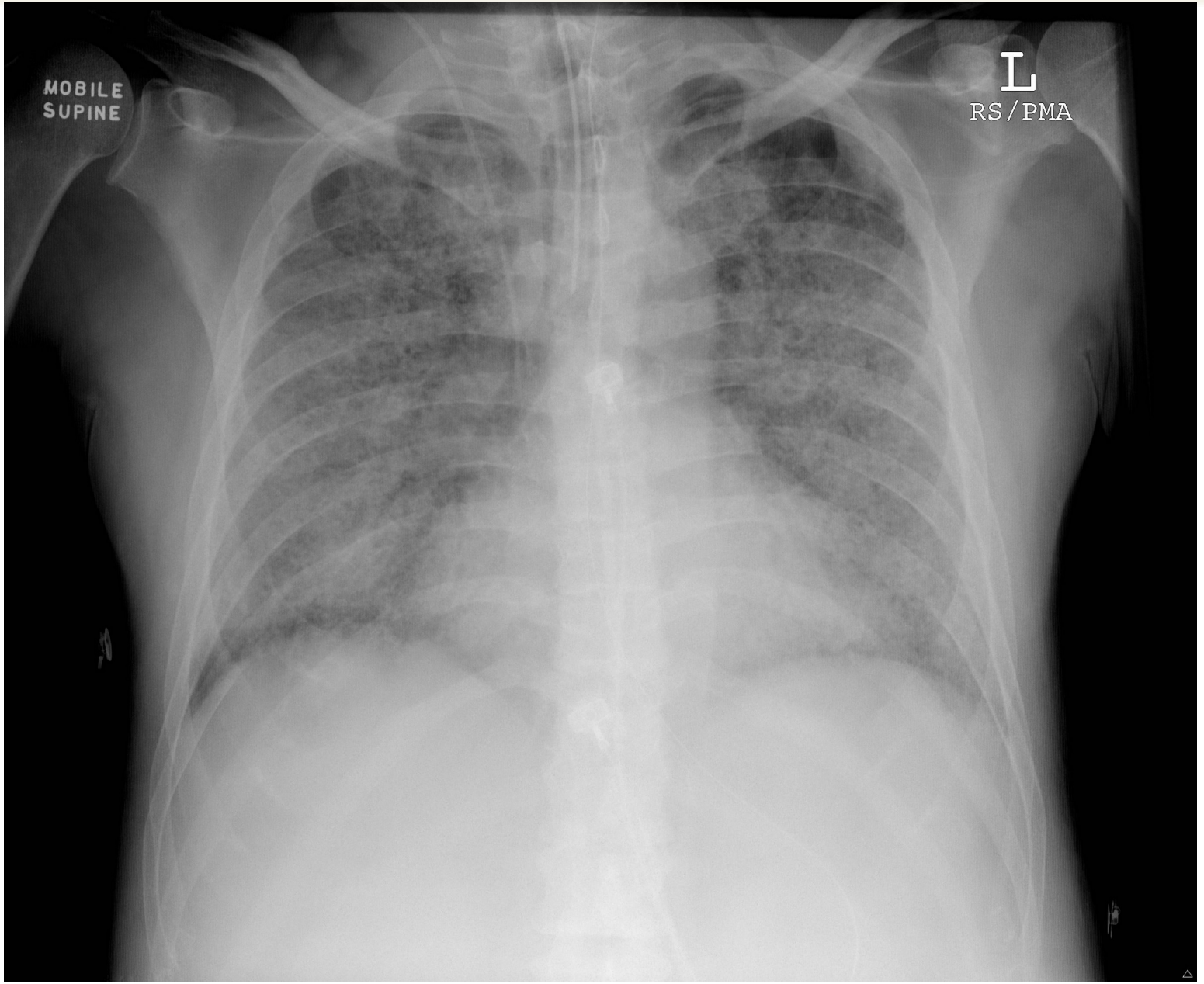
Pleural Effusions





Acute Respiratory Distress Syndrome

- Severe inflammatory reaction of the lungs to pulmonary damage
- Causes: Sepsis (most common), gastric aspiration, trauma, low perfusion, pancreatitis
- Inflammation leads to impaired gas change, inflammatory mediator release, and subsequently hypoxemia



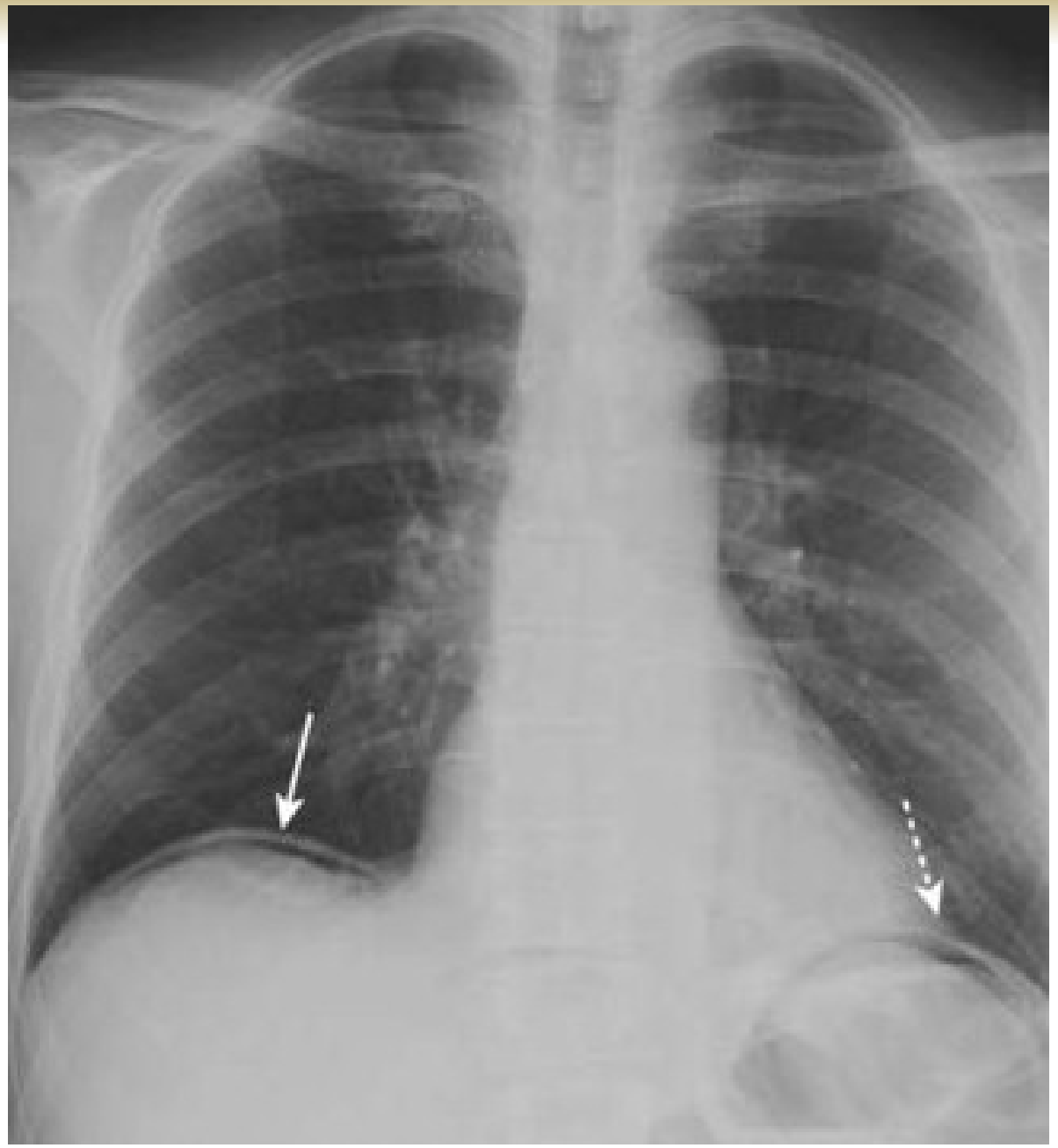
Typically presents with bilateral opacities on CXR

Case 4

A 43-year-old woman is brought to the ED for evaluation of worsening abdominal pain that suddenly started 2 hours ago. The patient also has nausea and has vomited twice. She has hypothyroidism, SLE, and chronic right knee pain. Current medications include levothyroxine, prednisone, and naproxen. She appears distressed. Her temperature is 37.9°C (100.2°F), pulse is 101/min, and blood pressure is 115/70 mm Hg.

Physical Examination

Examination shows a diffusely rigid abdomen with rebound tenderness; bowel sounds are hypoactive. Laboratory studies show a leukocyte count of 13,300/mm^3 and an erythrocyte sedimentation rate of 70 mm/h.



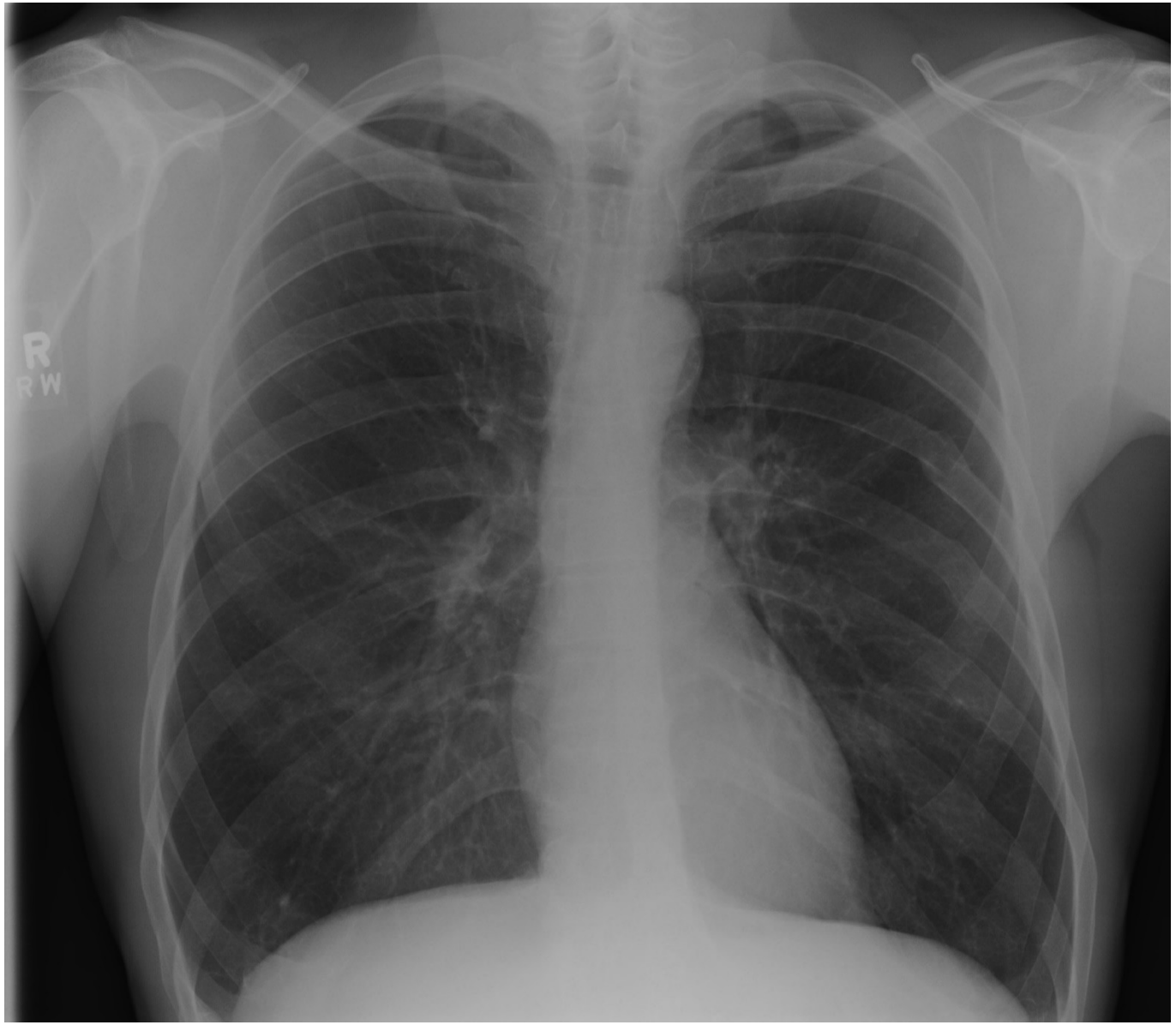
Case 4 - Pneumoperitoneum

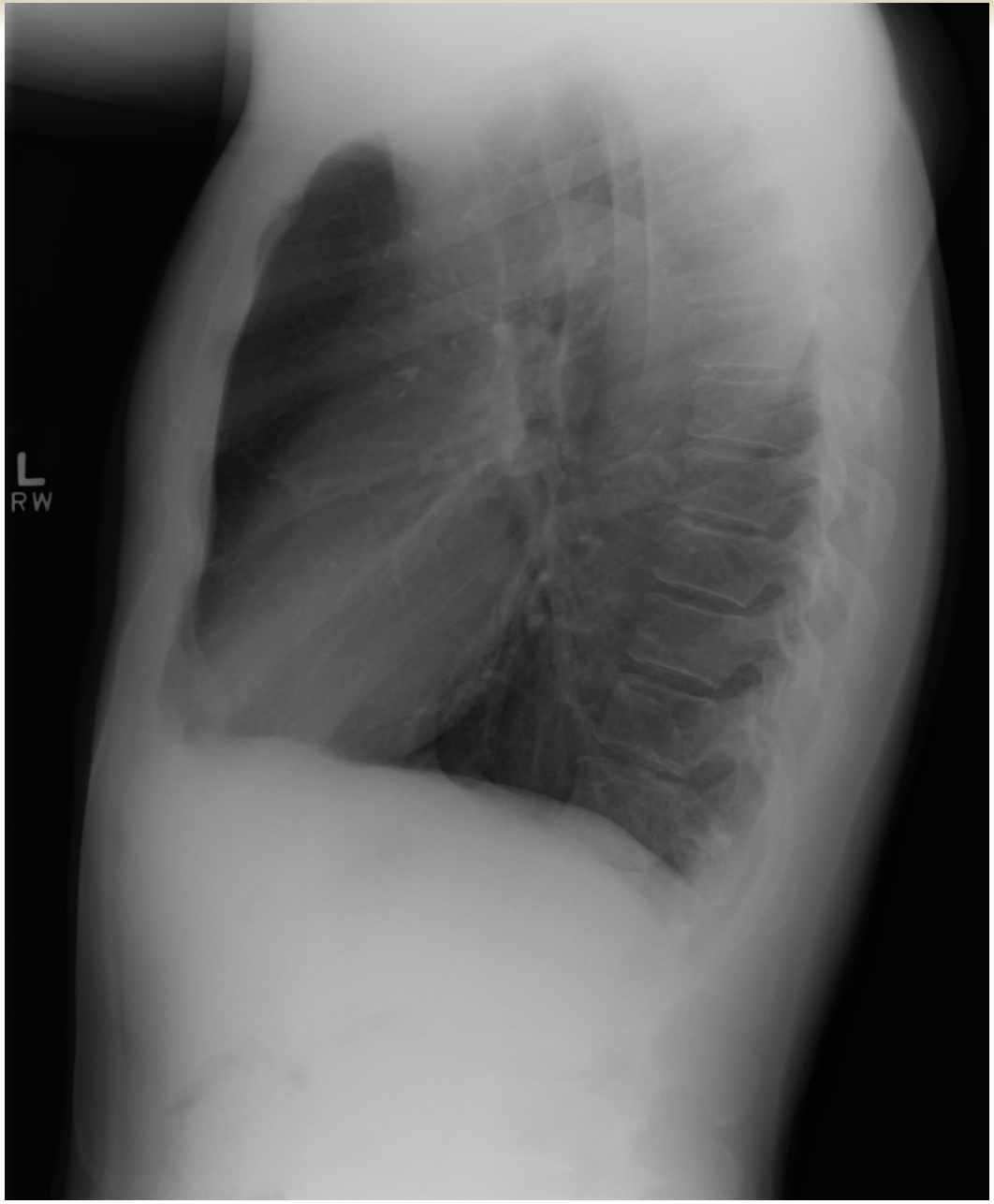
Case 5

A 68-year-old man comes to the physician for a routine health maintenance examination. He has had increasing shortness of breath and a productive cough for the past year. He can walk up a flight of stairs without stopping. He has HTN and his only medication is amlodipine. He has a history of asthma during childhood. He smoked 1 pack of cigarettes daily for 30 years but quit 16 years ago. His pulse is 98/min, respirations are 25/min and blood pressure is 134/88 mm Hg. Pulse oximetry on room air shows an oxygen saturation of 93%.

Physical Examination

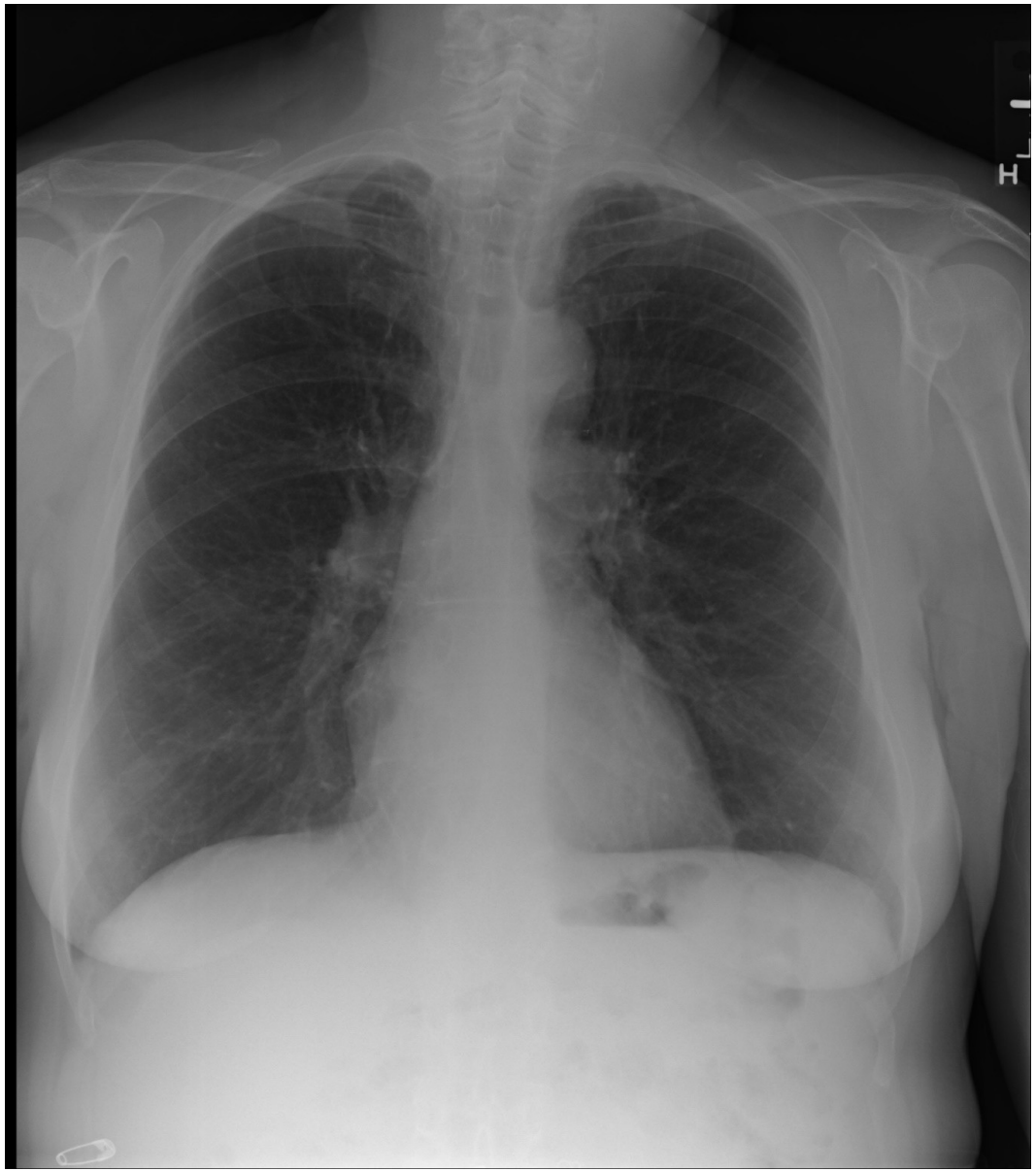
Scattered expiratory wheezing and rhonchi are heard throughout both lung fields. Cardiac examination shows no murmurs, rubs, or gallops. Spirometry shows an FEV_1:FVC ratio of 63% and an FEV_1 of 65% of predicted. His diffusing capacity for carbon monoxide (DL_{co}) is 40% of predicted.

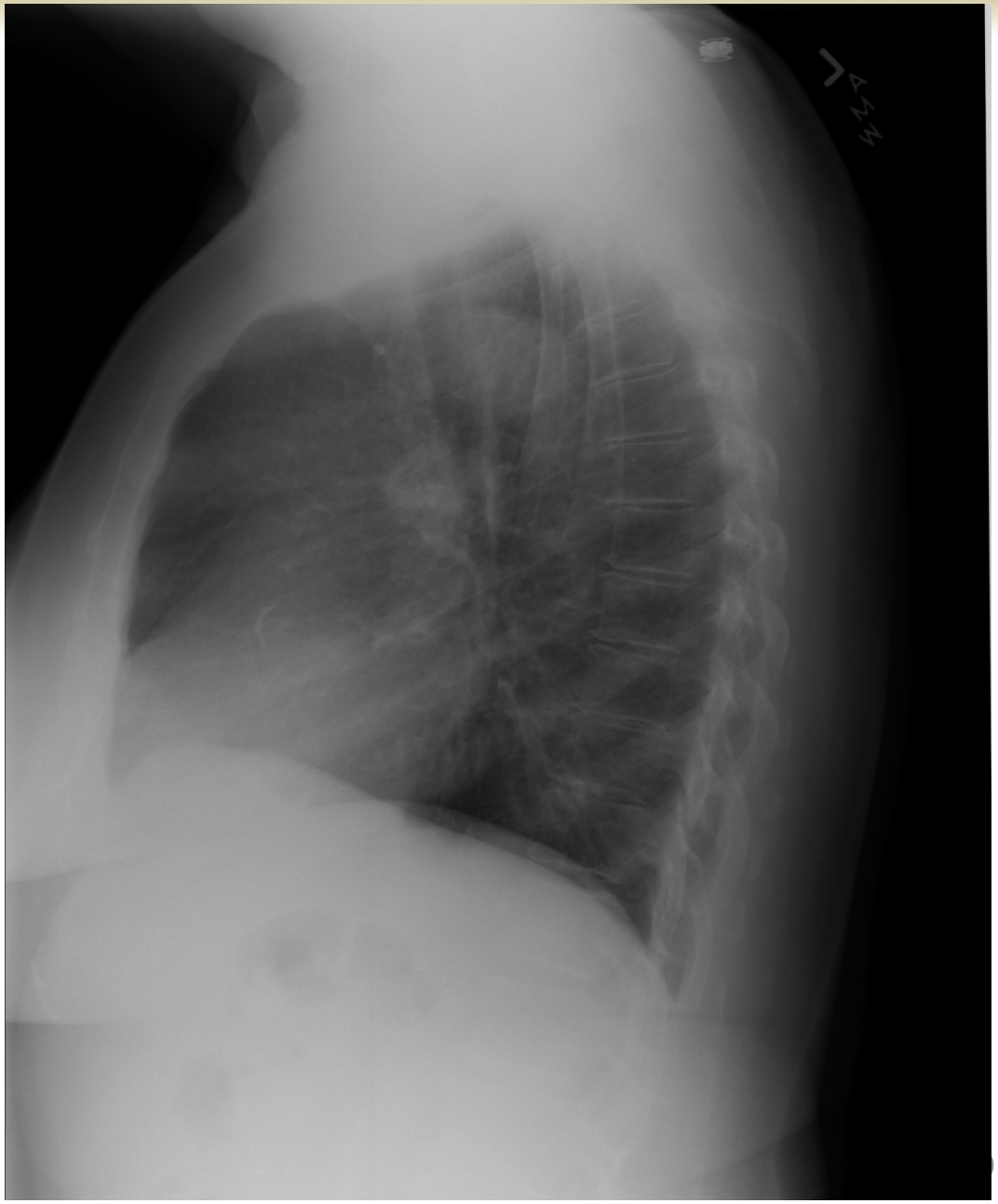

R
RW

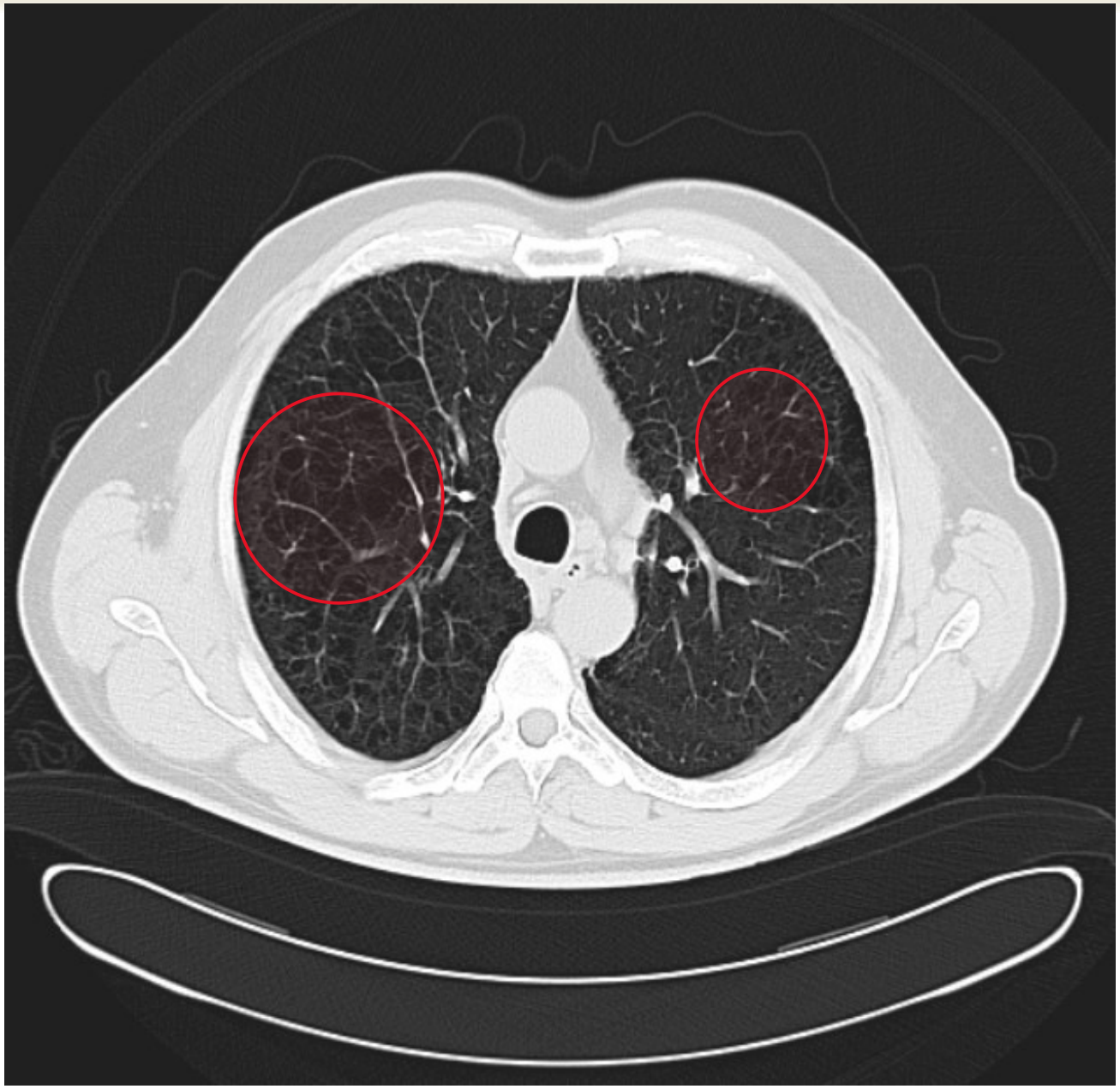

L
RW

Case 5 - Pulmonary hyperinflation

- May be due to obstructive lung pathology
- Increased anteroposterior diameter; barrel chest
- Pushed down and flattened diaphragm
- Horizontal ribs and widened intercostal spaces
- Hyperlucency of lung tissue (decreased lung markings)







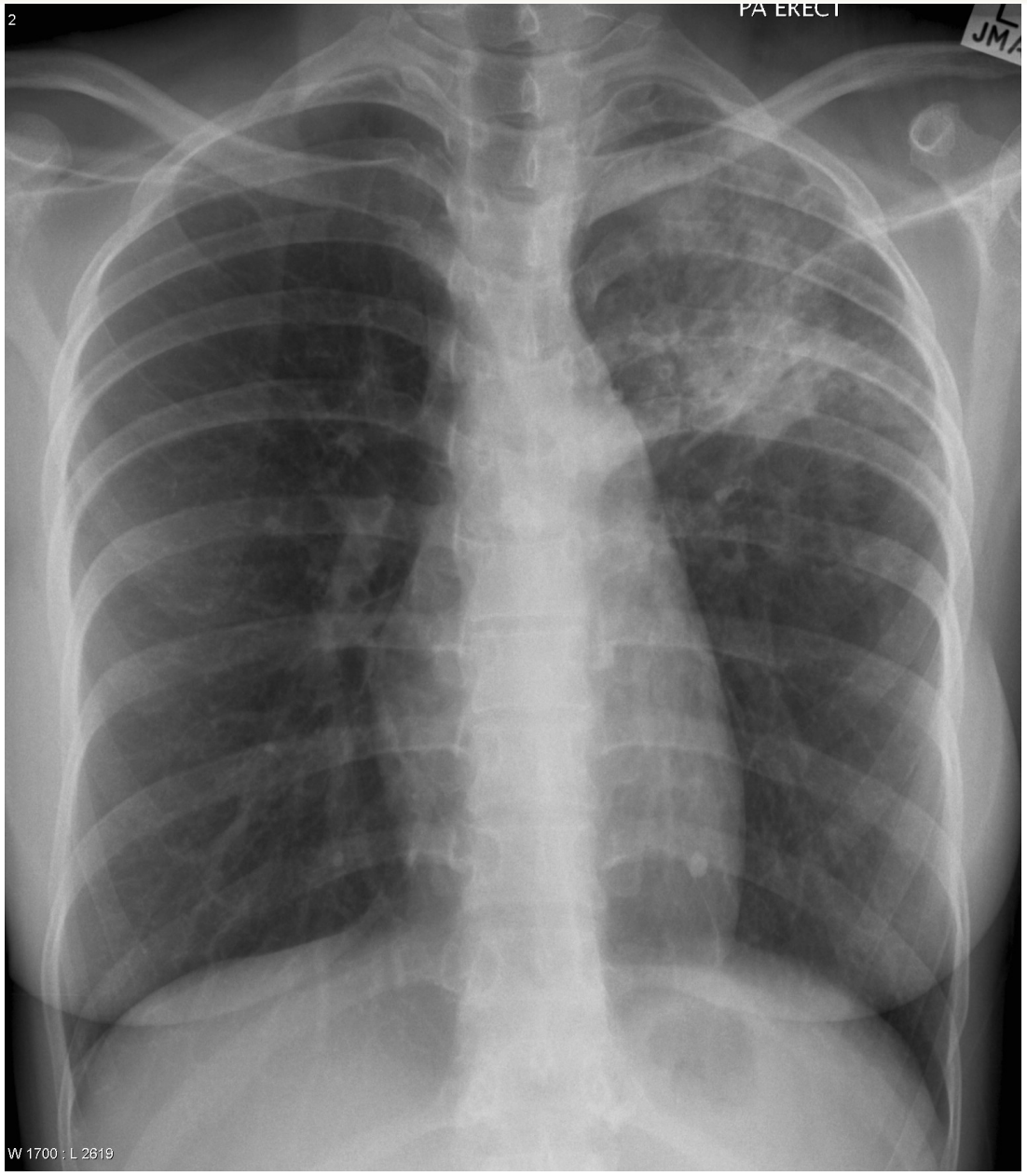
Centrilobular pulmonary emphysema

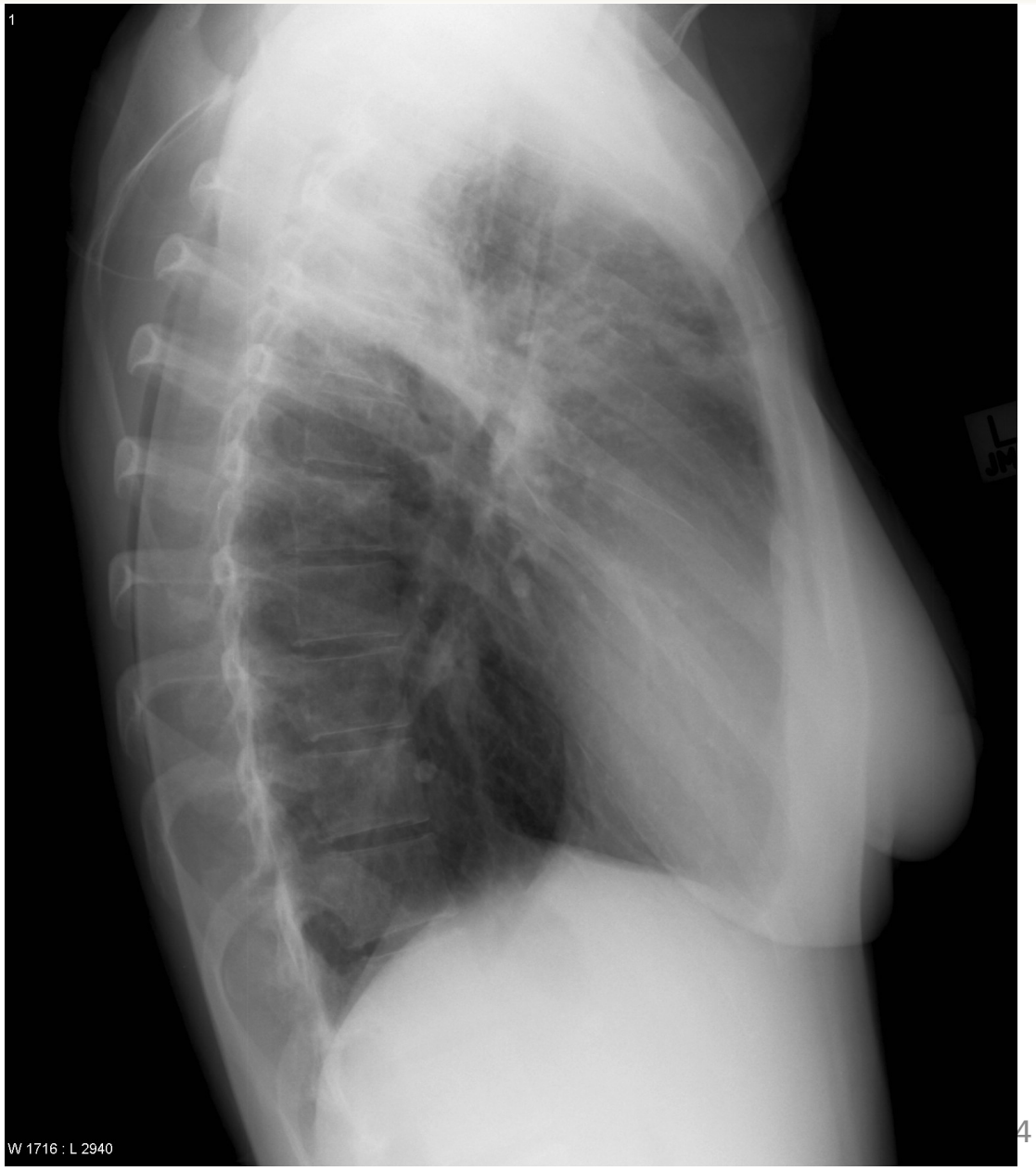
Case 6

A 63-year-old woman comes to the physician because of shortness of breath and swollen extremities for 2 weeks. She has had excessive night sweats and a 4-kg (8.8-lb) weight loss over the last 8 weeks. She had an anterior myocardial infarction 3 years ago. He has T2DM and HTN. She immigrated from Indonesia 4 months ago and works in a shipyard. She has smoked one pack of cigarettes daily for 48 years. Current medications include insulin, aspirin, simvastatin, metoprolol, and ramipril.

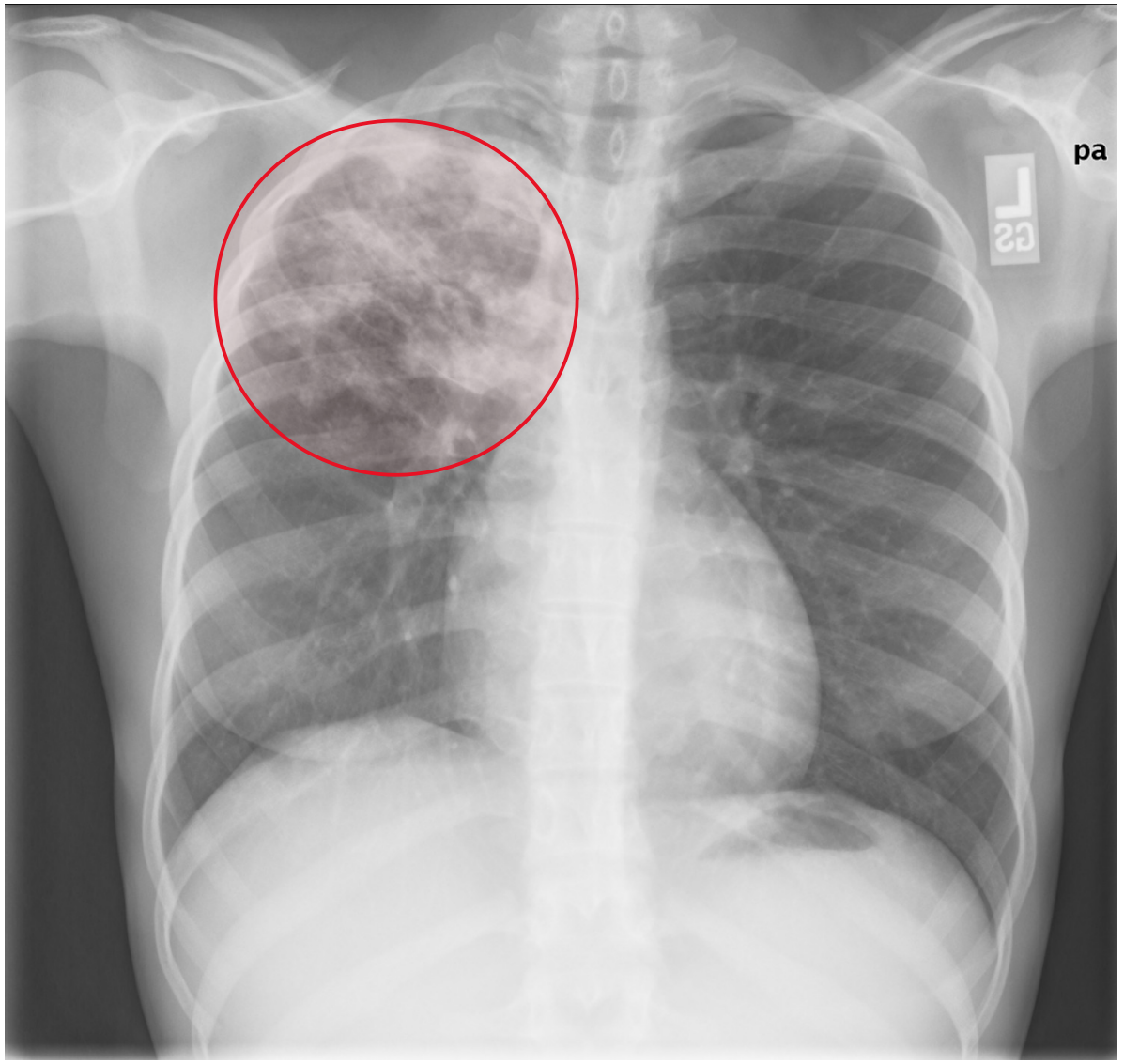
Physical Examination

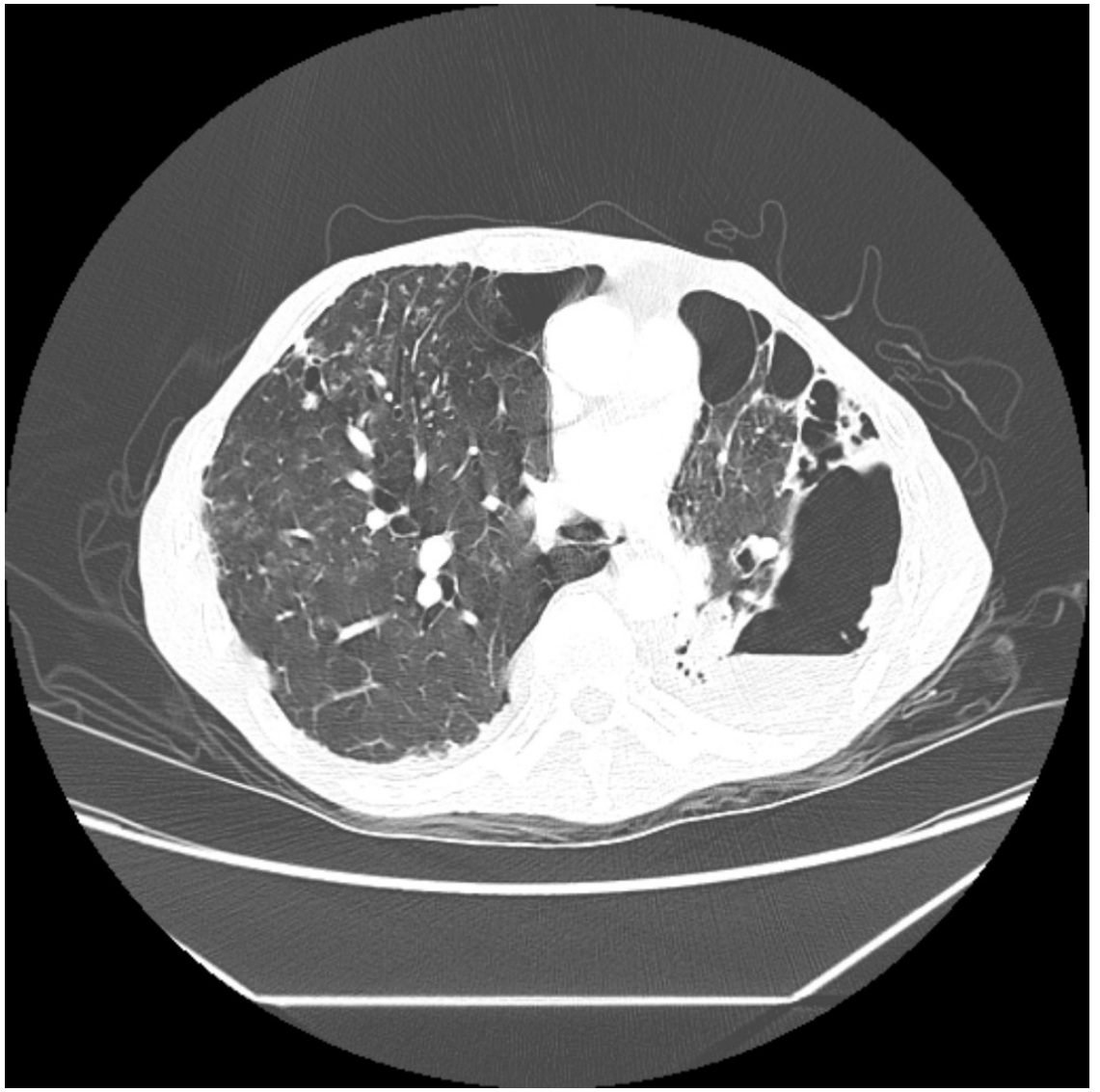
She is 160 cm (5 ft 3 in) tall and weighs 46.7 kg (103 lb); BMI is 18 kg/m^2. Her temperature is 38.0°C (100.4°F), pulse is 104/min, respirations are 20/min, and blood pressure is 135/95 mm Hg. Examination shows generalized pitting edema. There is jugular venous distention, hepatomegaly, and a paradoxical increase in jugular venous pressure on inspiration.


2
PA ERECT
W 1700 : L 2619


1
W 1716 : L 2940

Case 6 - Pulmonary tuberculosis

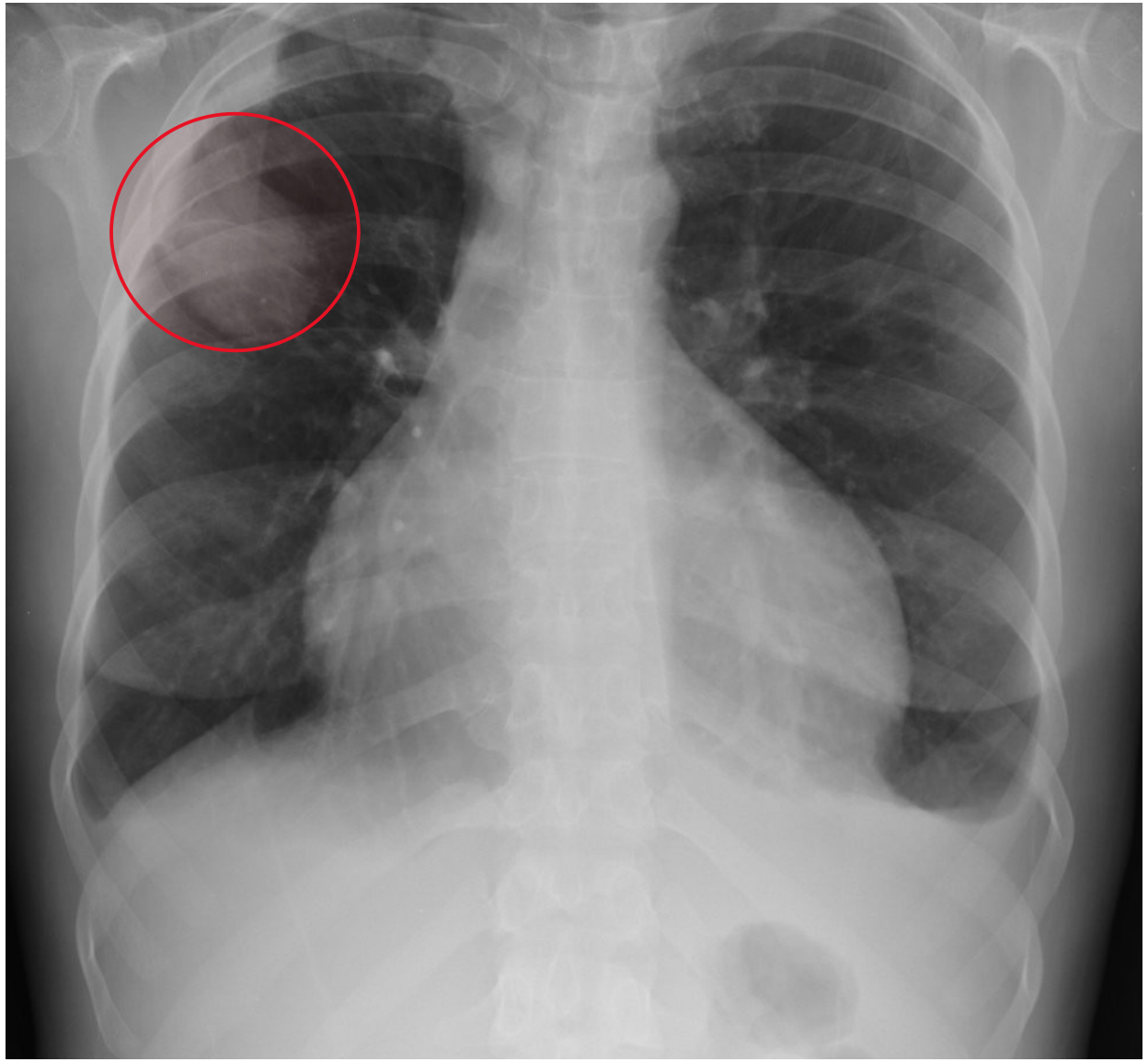




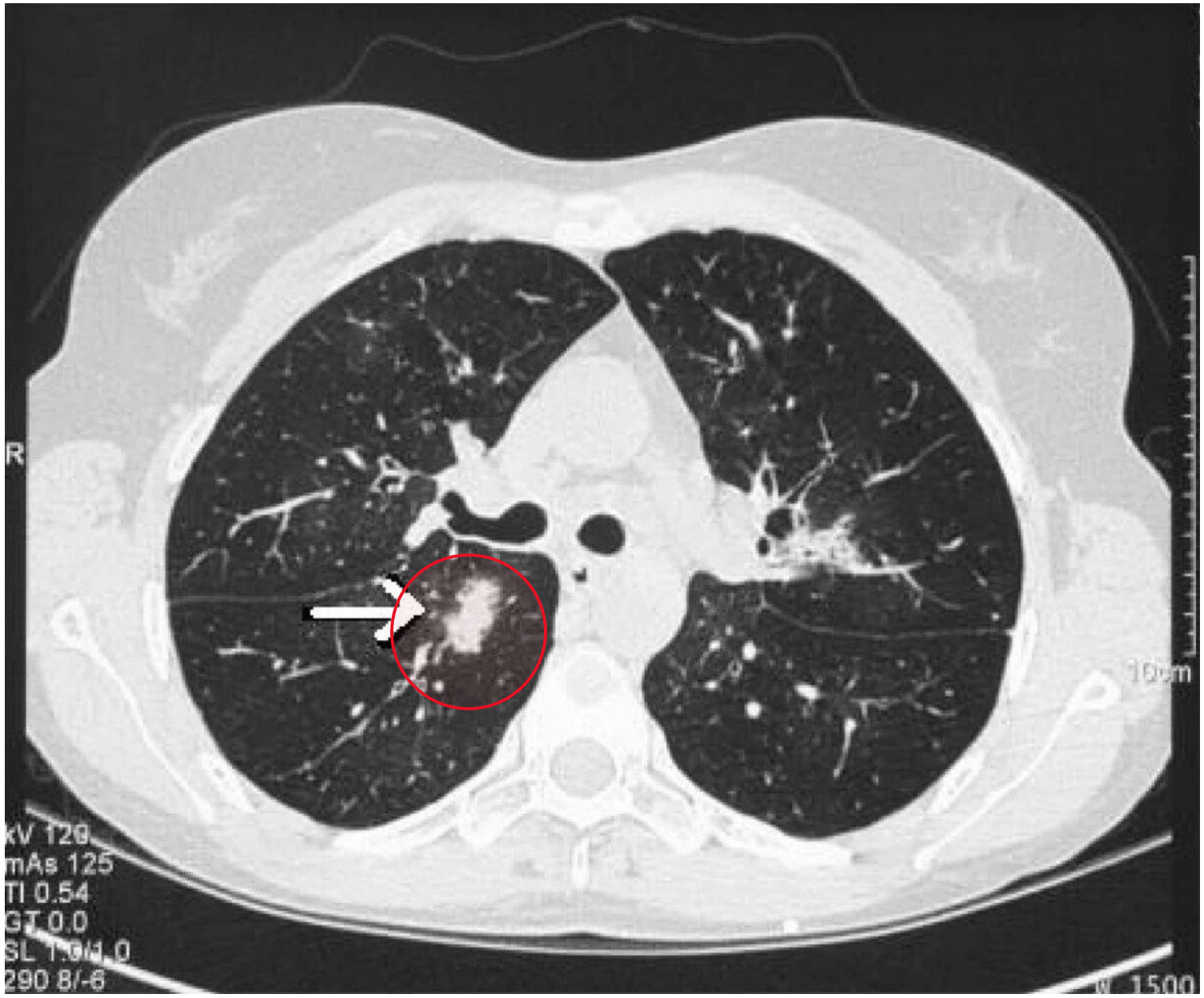
Other pulmonary manifestations

Sarcoidosis – bilateral hilar lymphadenopathy

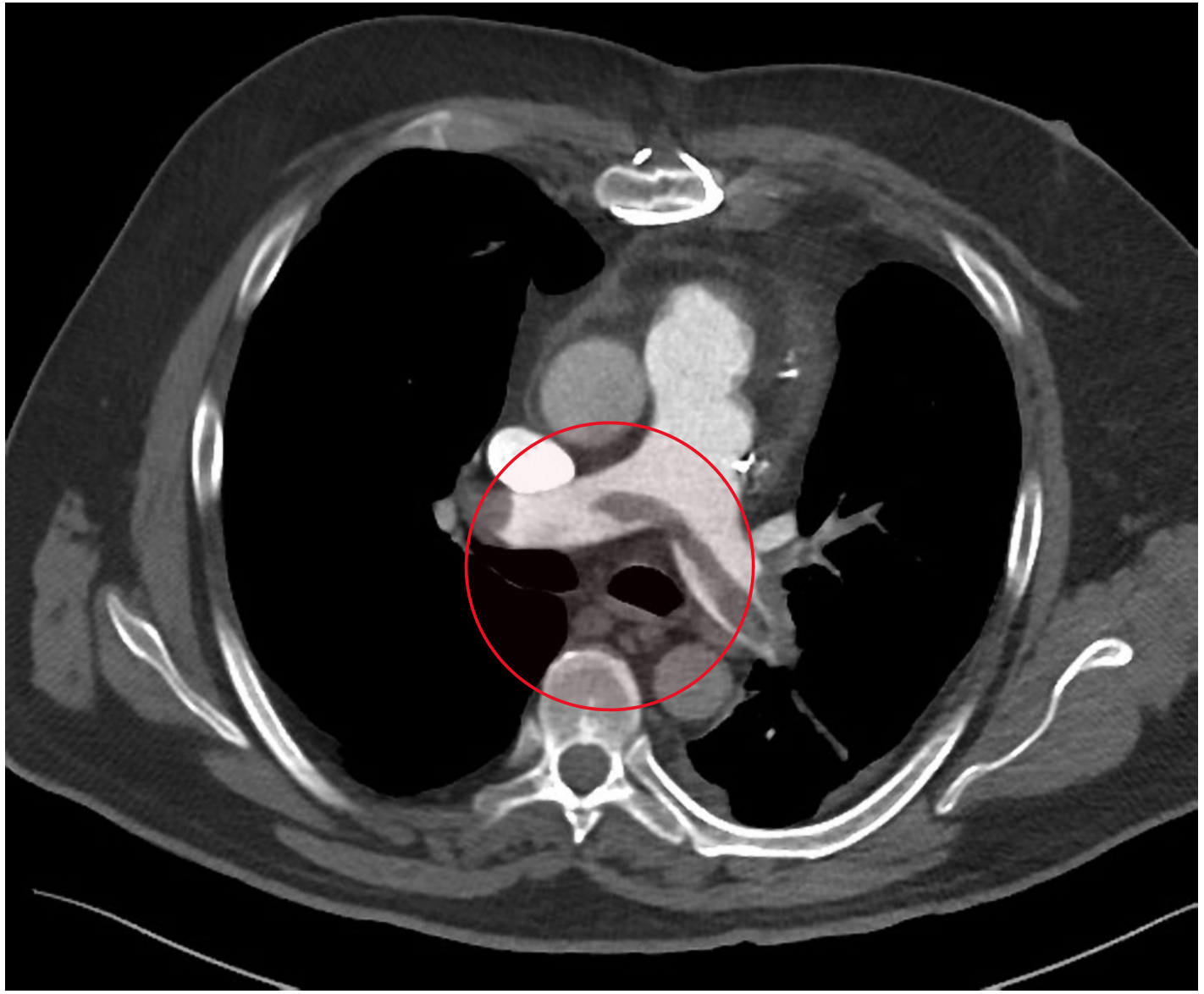
Other pulmonary manifestations



Aspergillosis – diffuse reticulonodular opacities in both lungs with numerous larger nodules interspersed throughout



"Halo sign" seen on CT classically associated with Angioinvasive aspergillosis



Pulmonary embolus – seen as filling defect on Chest CT Angiogram.

- May have "saddle" morphology.

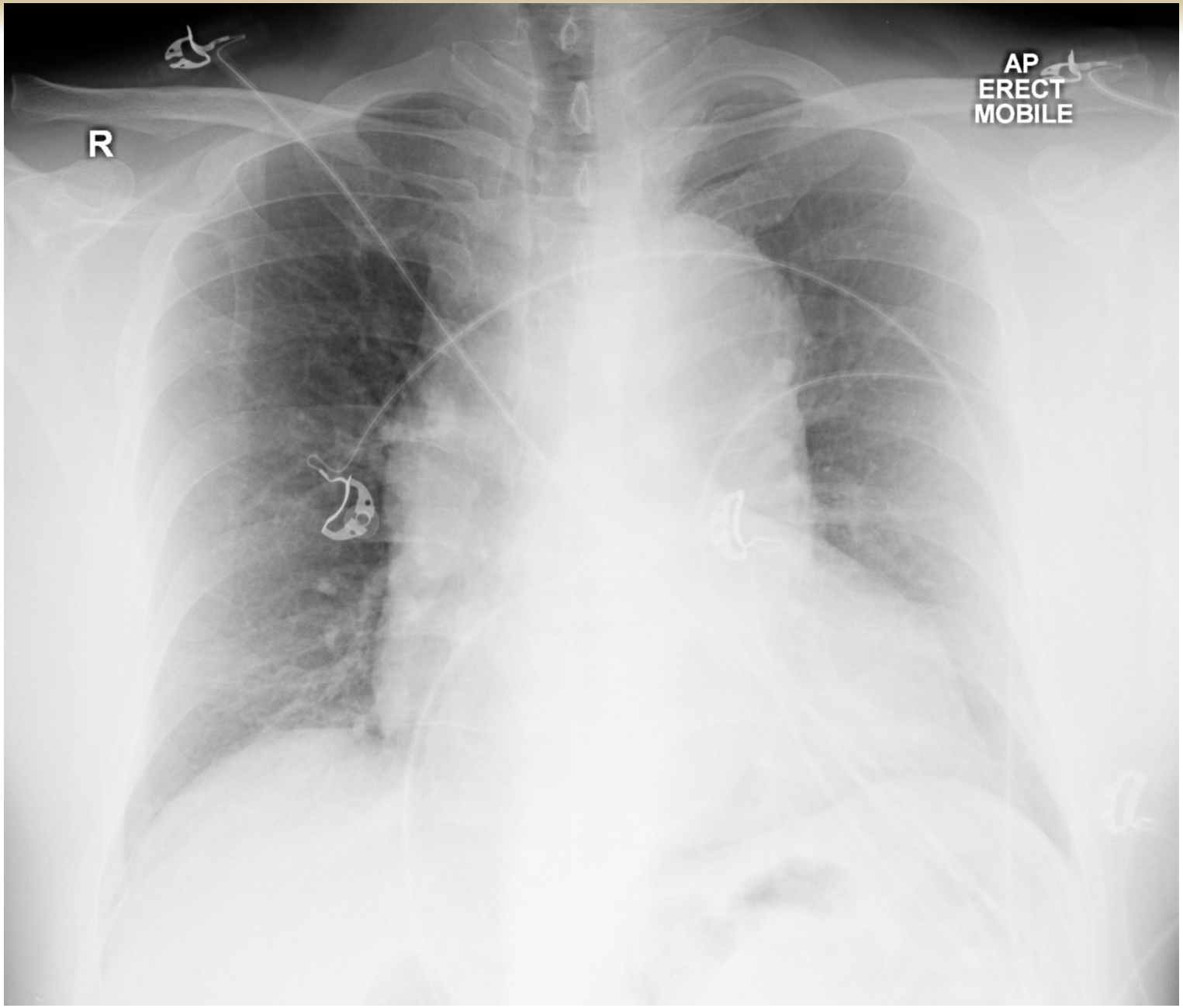
Modified Wells criteria for pretest probability of pulmonary embolism
Score +3 points • Clinical signs of DVT • Alternate diagnosis less likely than PE **Score +1.5 points** • Previous PE or DVT • Heart rate >100 • Recent surgery or immobilization **Score +1 point** • Hemoptysis • Cancer **Total score for clinical probability** < 4 = PE unlikely > 4 = PE likely
DVT = deep venous thrombosis; **PE** = pulmonary embolism.

Case 7

A 75-year-old man comes to the emergency department because of severe chest pain for the past hour. The patient describes the pain as located in the middle of his chest and tearing in quality. He has a history of HTN, HLD, and T2DM. He has smoked a pack of cigarettes daily for the past 30 years. He drinks 2-3 beers daily. Medications include enalapril, atorvastatin, and metformin. He says that he has not been taking his medications on a regular basis.

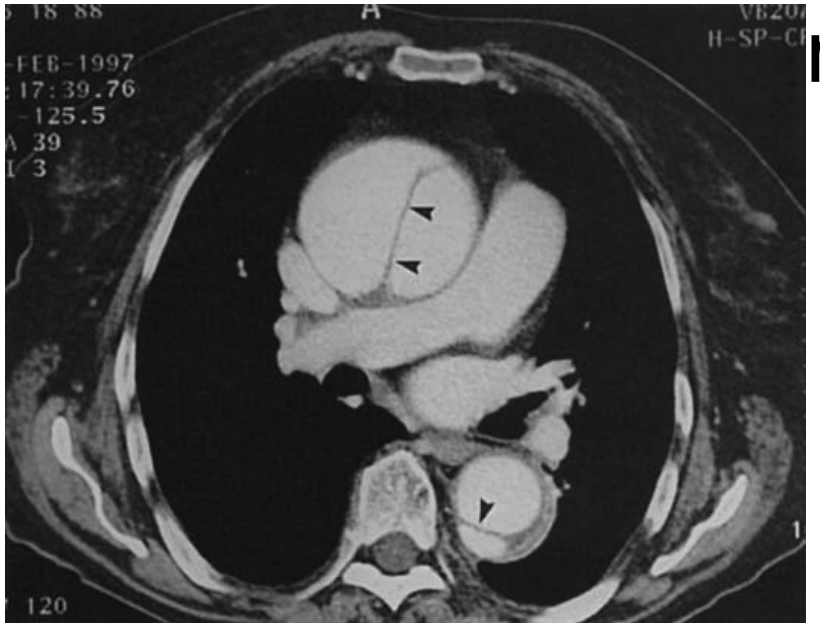
Case 7

He is 174 cm (5 ft 9 in) tall and weighs 98 kg (216 lb); BMI is 32 kg/m2. His pulse is 80/min, and blood pressure is 150/90 mm Hg in his right arm and 180/100 mm Hg in his left arm. Cardiac examination shows a high-pitched, blowing, decrescendo early diastolic murmur. ECG shows no abnormalities. An x-ray of the chest is shown.

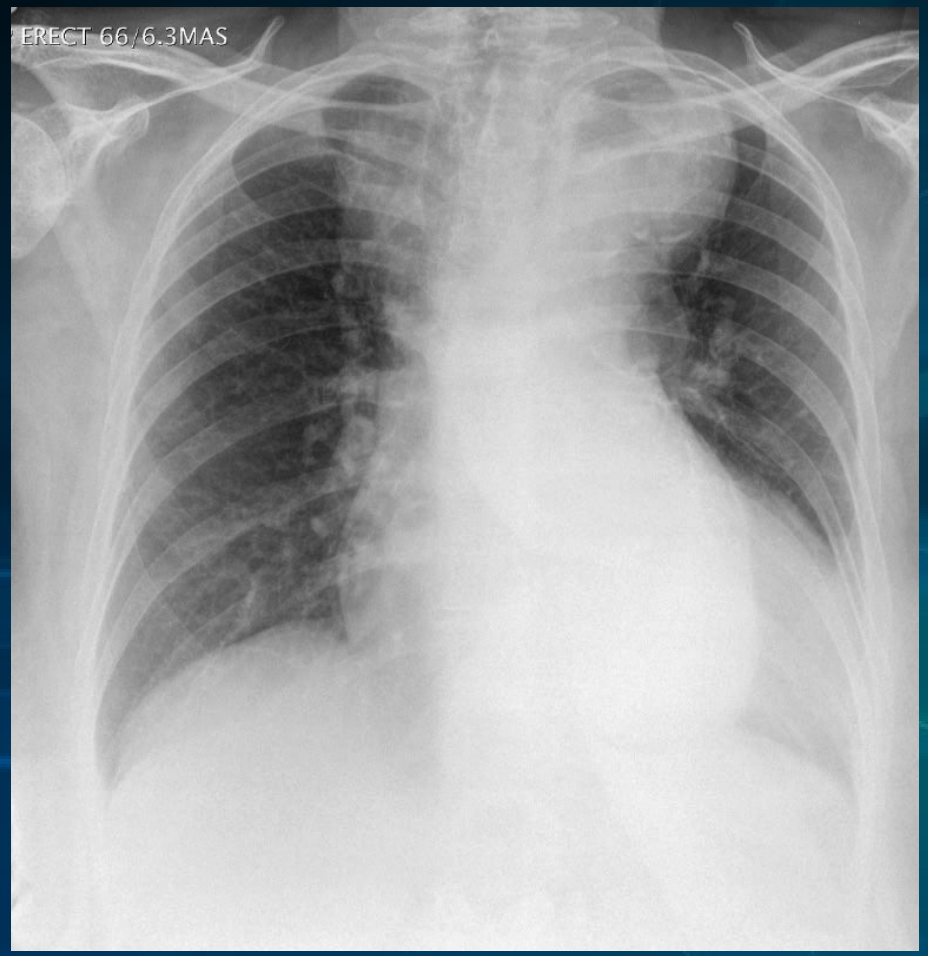

R
AP
ERECT
MOBILE

Case 7 - Aortic Dissection

- Hypertension considered the strongest risk factor
- Widened mediastinum seen on chest x-ray imaging
- Associated with tearing/ripping chest (ascending aorta) or back (descending aorta) pain
- Asymmetrical [redacted]ngs between limbs

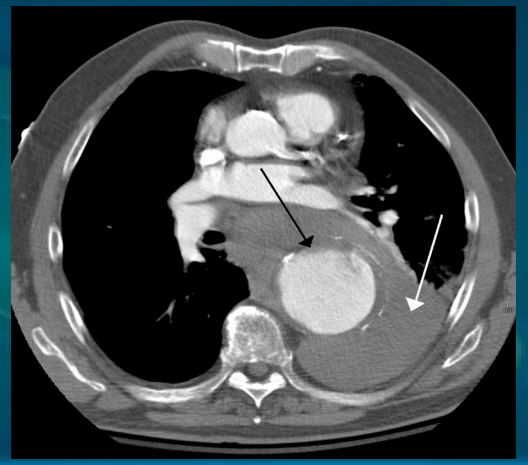


Chest Radiography: Widened mediastinum



Widened mediastinum

Mediastinal hematoma
Lymphadenopathy
Mass



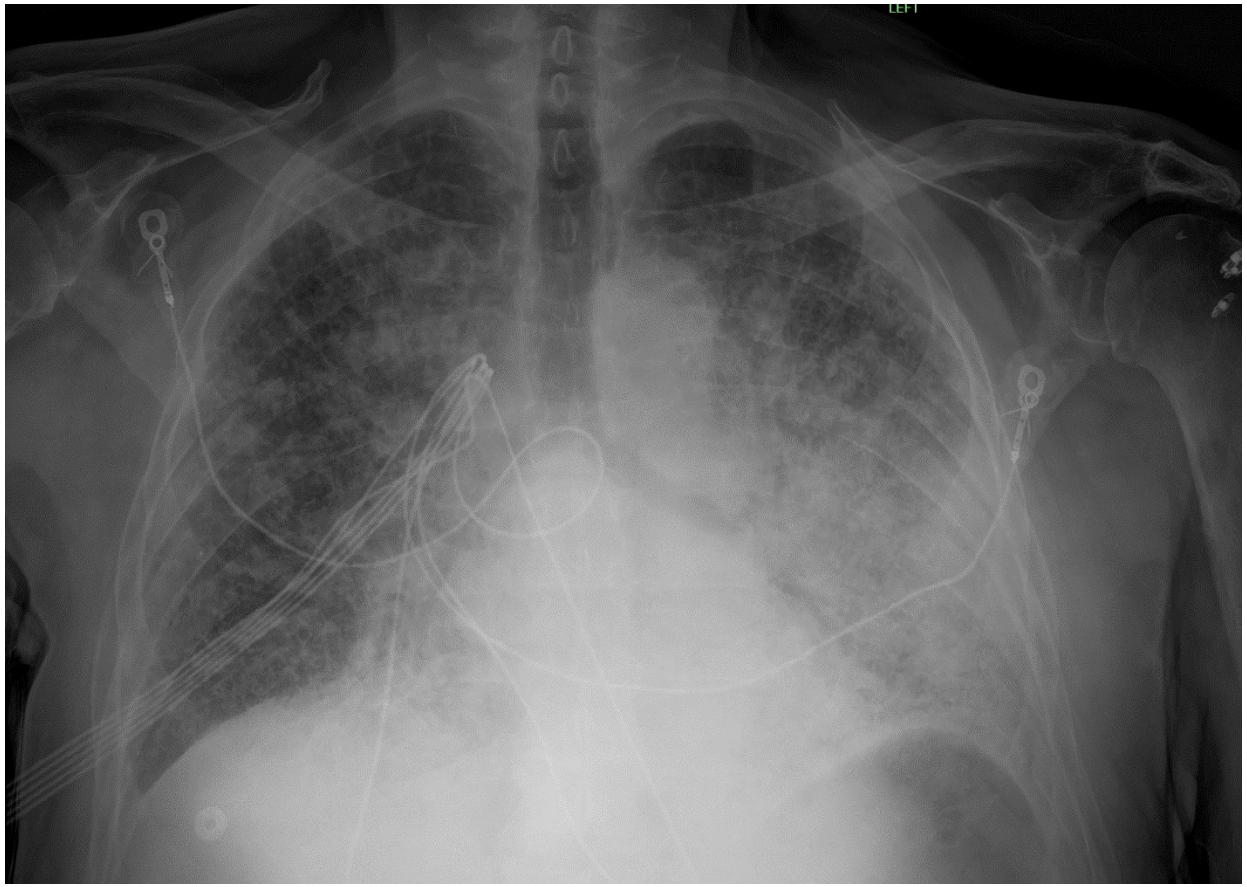
Case 8

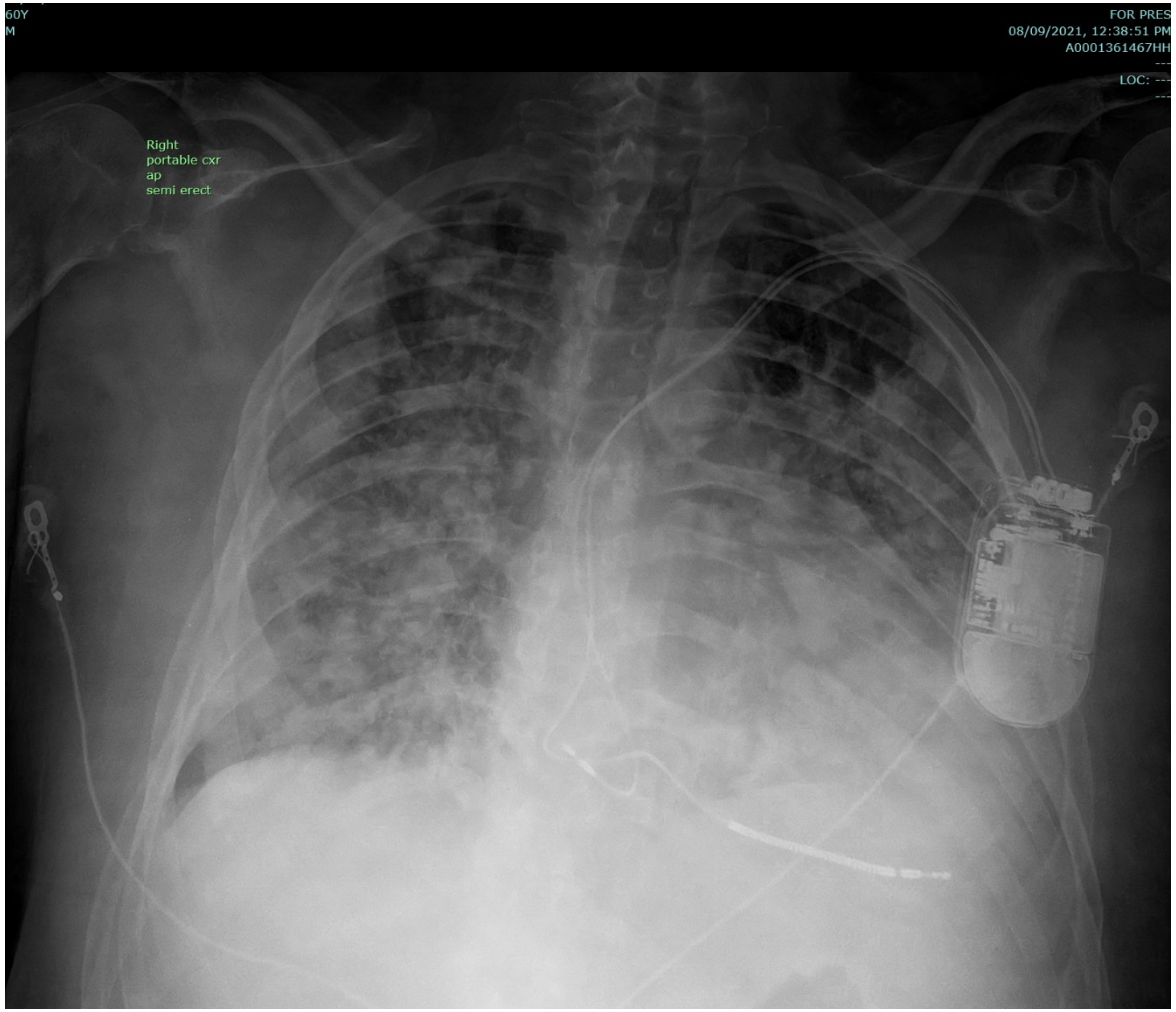
A 72-year-old man is admitted to the hospital because of a 1-day history of worsening cough, shortness of breath, and fever. The patient lives with his wife, who was diagnosed with COVID-19 1 week ago. He has no history of major medical illness and takes no medications. His temperature is 38.7°C (98.6°F), pulse is 102/min, respirations are 28/min, and blood pressure is 115/70 mm Hg. Pulse oximetry on room air shows an oxygen saturation of 91%. A reverse transcriptase-polymerase chain reaction of a nasopharyngeal specimen is positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

Right
AP Upright

Case 8 - COVID-19

- Bilateral patchy infiltrates
- Hallmark is bilateral ground glass opacities in a peripheral distribution
- Not usually associated with pleural effusion
- Incidence of PE is reported in 2.6-8.9% of hospitalized patients and up to a third of ICU patients
- Can lead to long term lung disease/fibrosis


LEFT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FOR PRES
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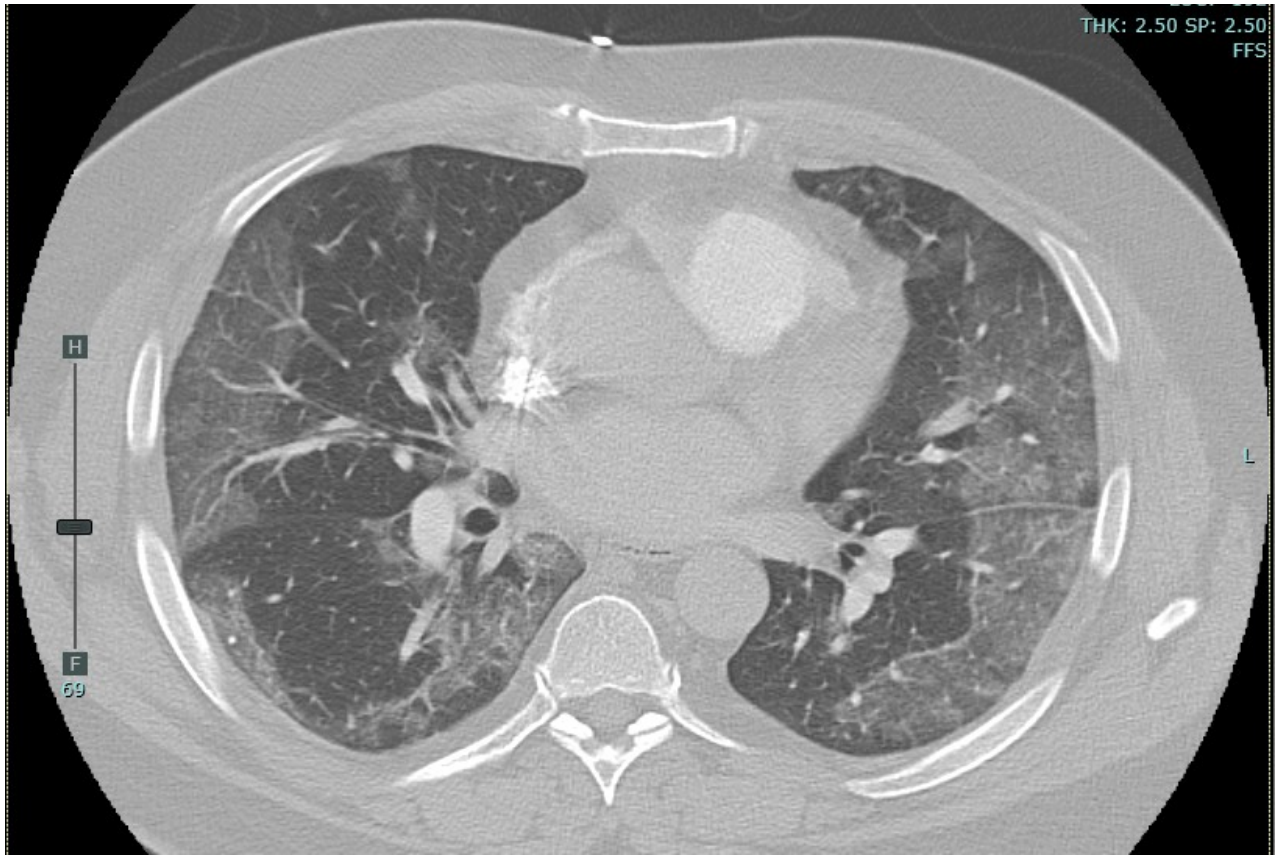
LOC:
Right
portable cxr
ap
semi erect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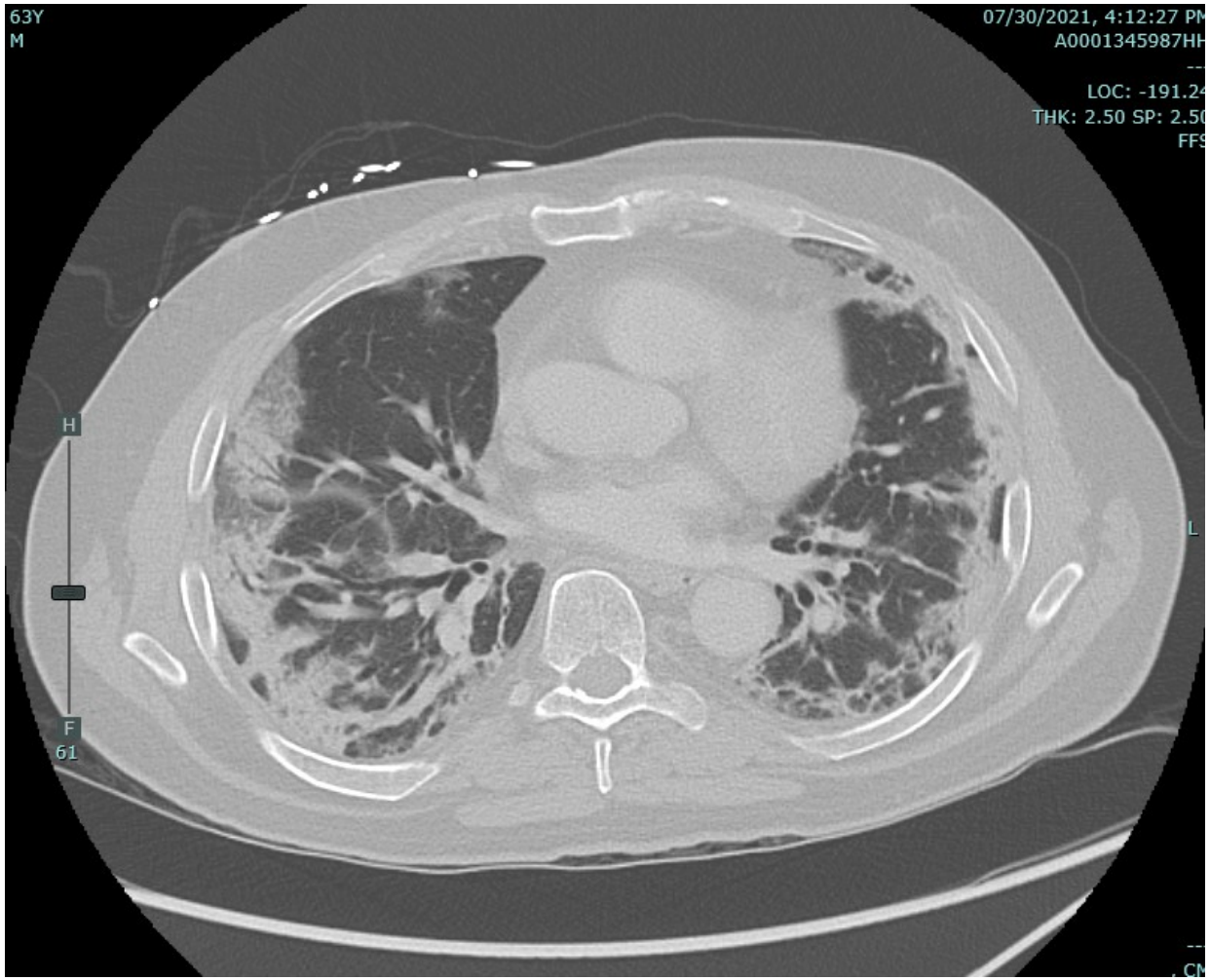
FFS
H
F
69
L


63Y
M
07/30/2021, 4:12:27 PM
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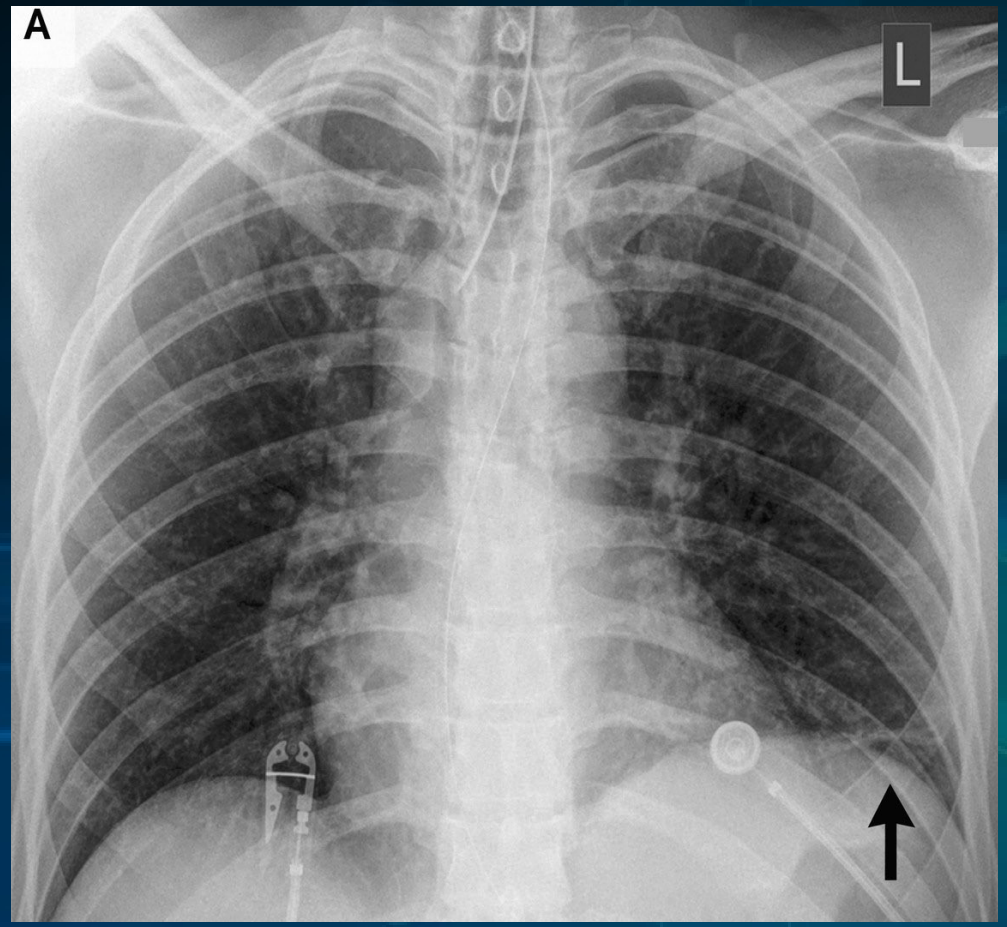
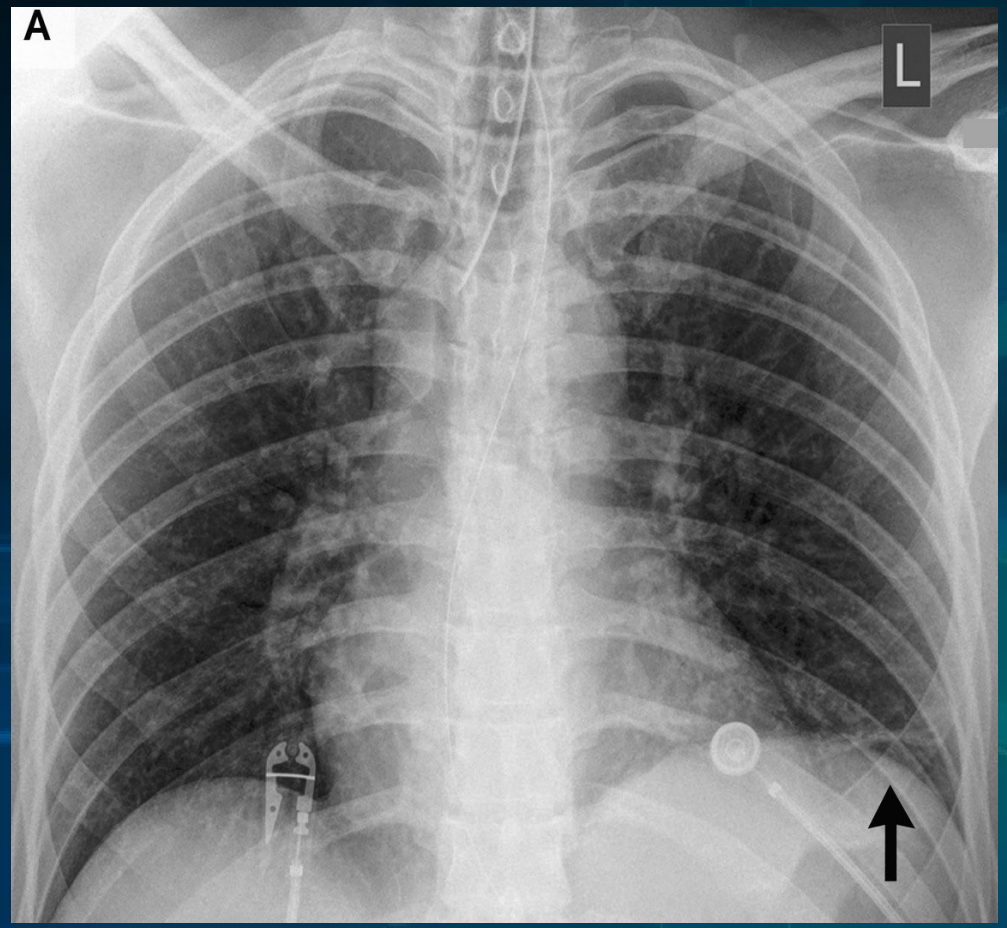
LOC: -191.24
THK: 2.50 SP: 2.50
FFS
H
F
61
L

Chest Radiography:



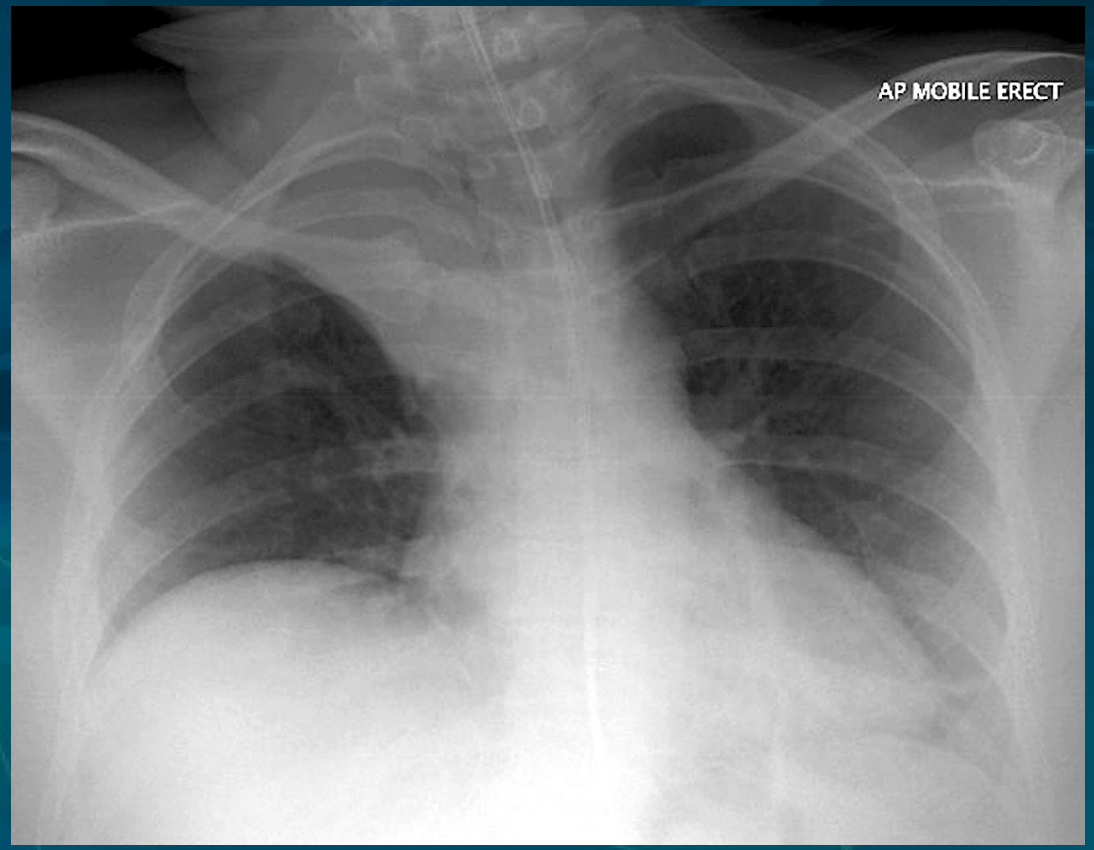
Chest Radiography: Atelectasis



Atelectasis
Opacification due to collapse of airspaces

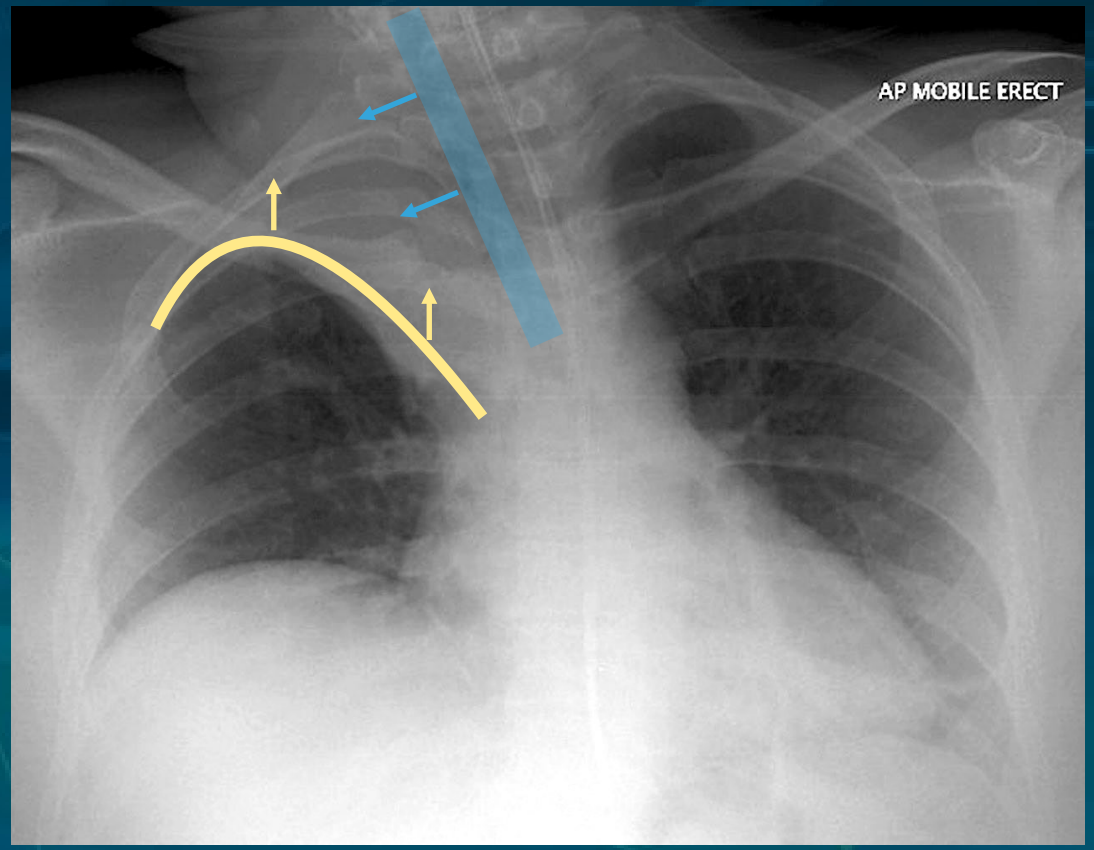
“Discoid” or “platelike” atelectasis is a common finding in the lung bases

Chest Radiography: Atelectasis

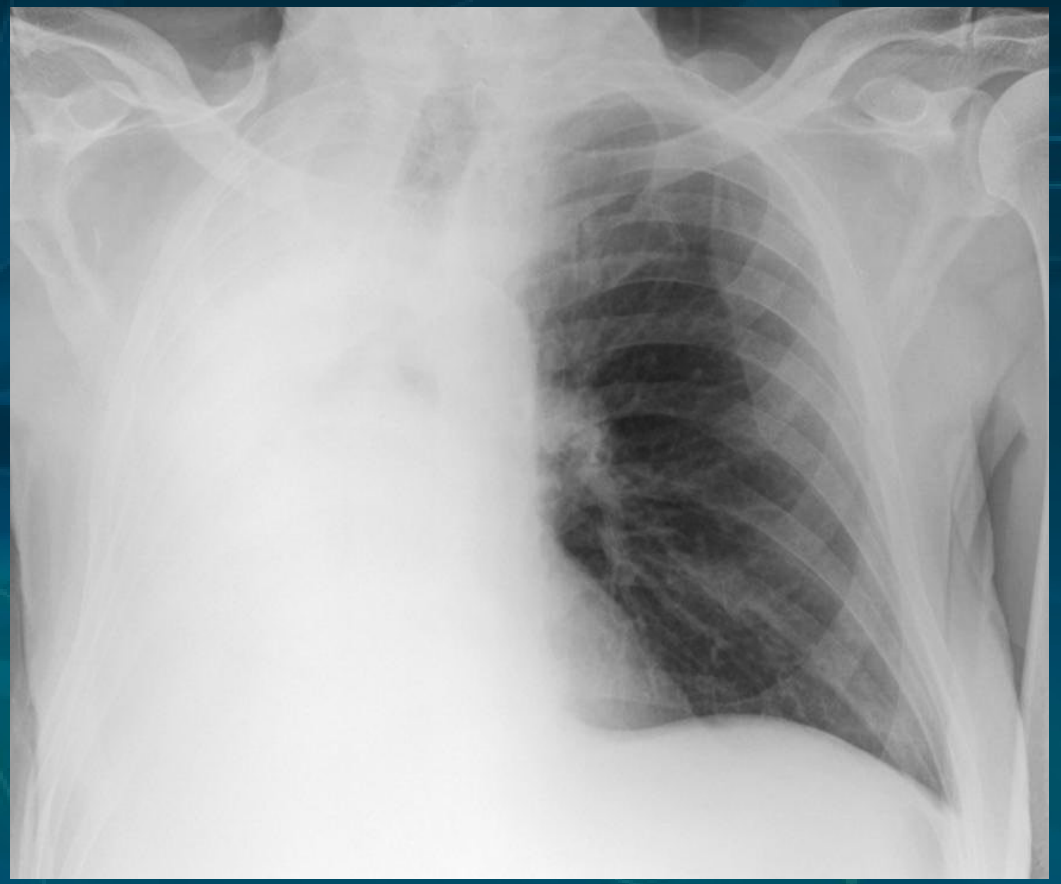


Chest Radiography: Atelectasis

Atelectasis
Right upper lobar atelectasis showing signs of volume loss, including distortion of fissures and shift of trachea

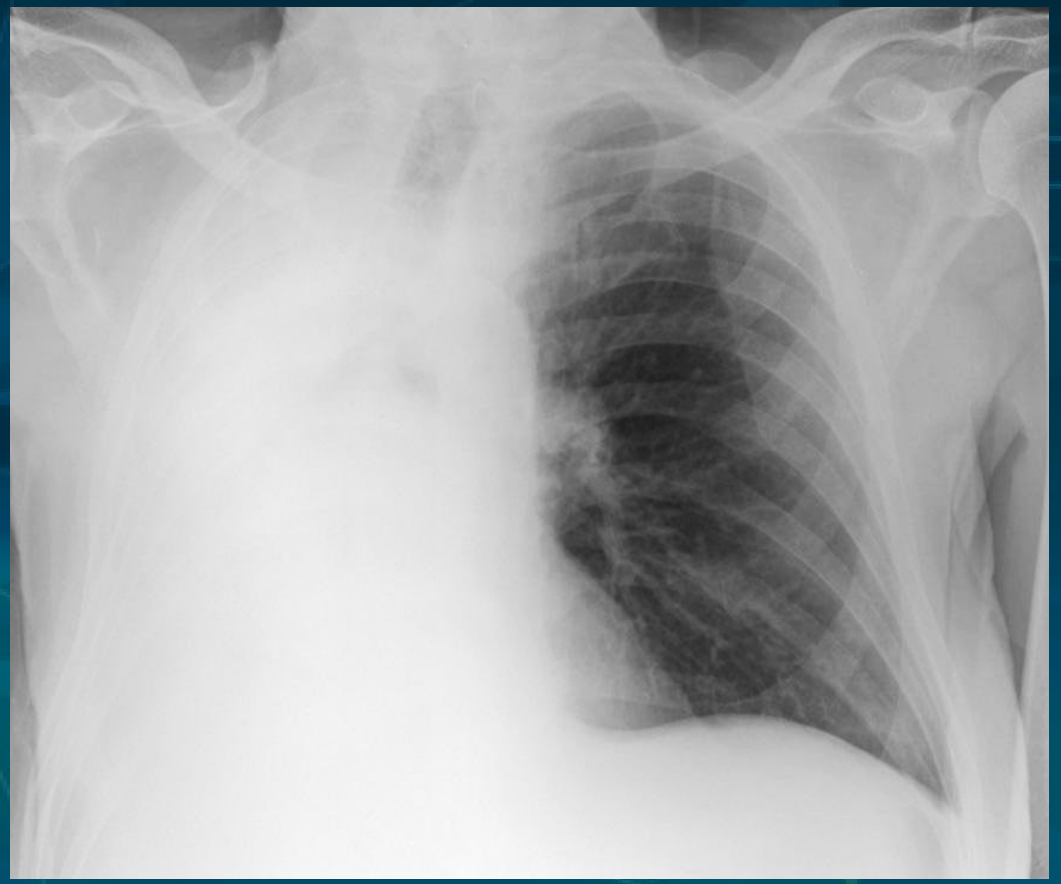


Chest Radiography: Atelectasis

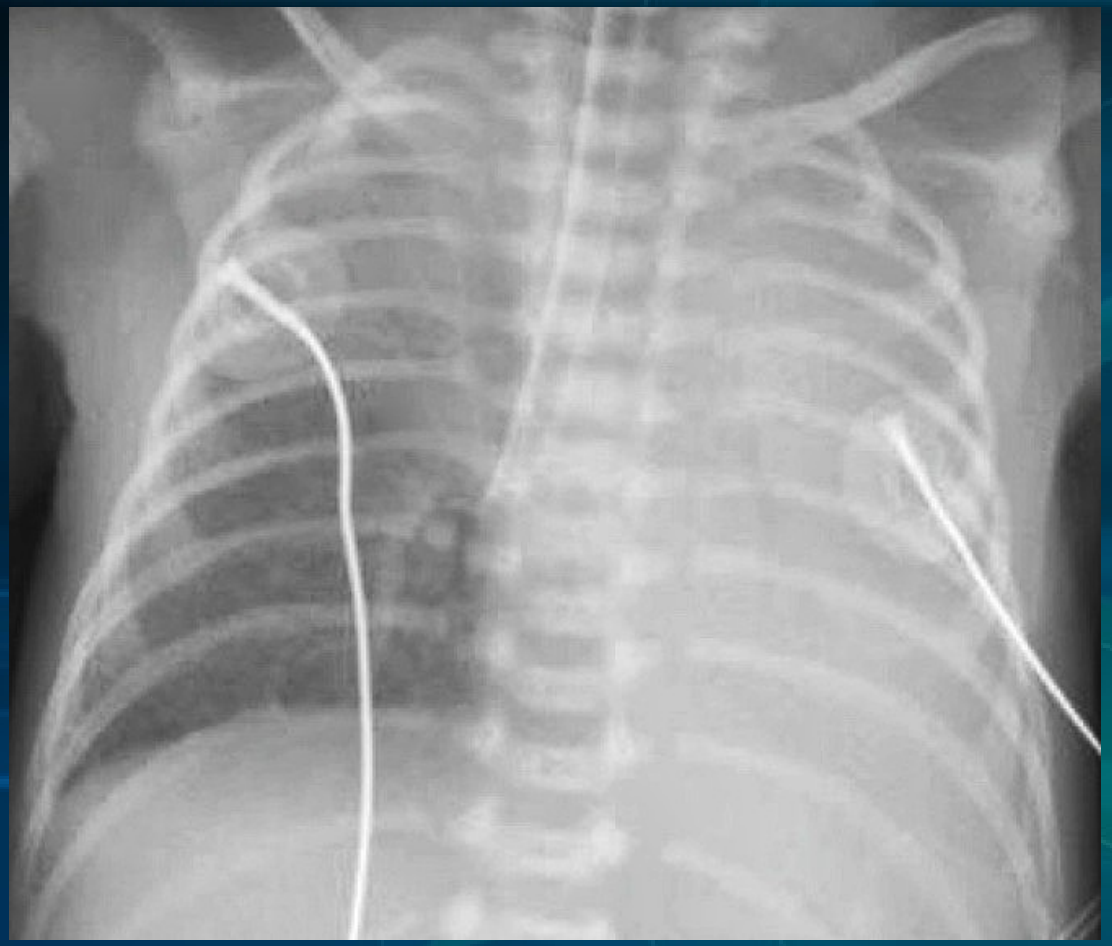


Chest Radiography: Atelectasis

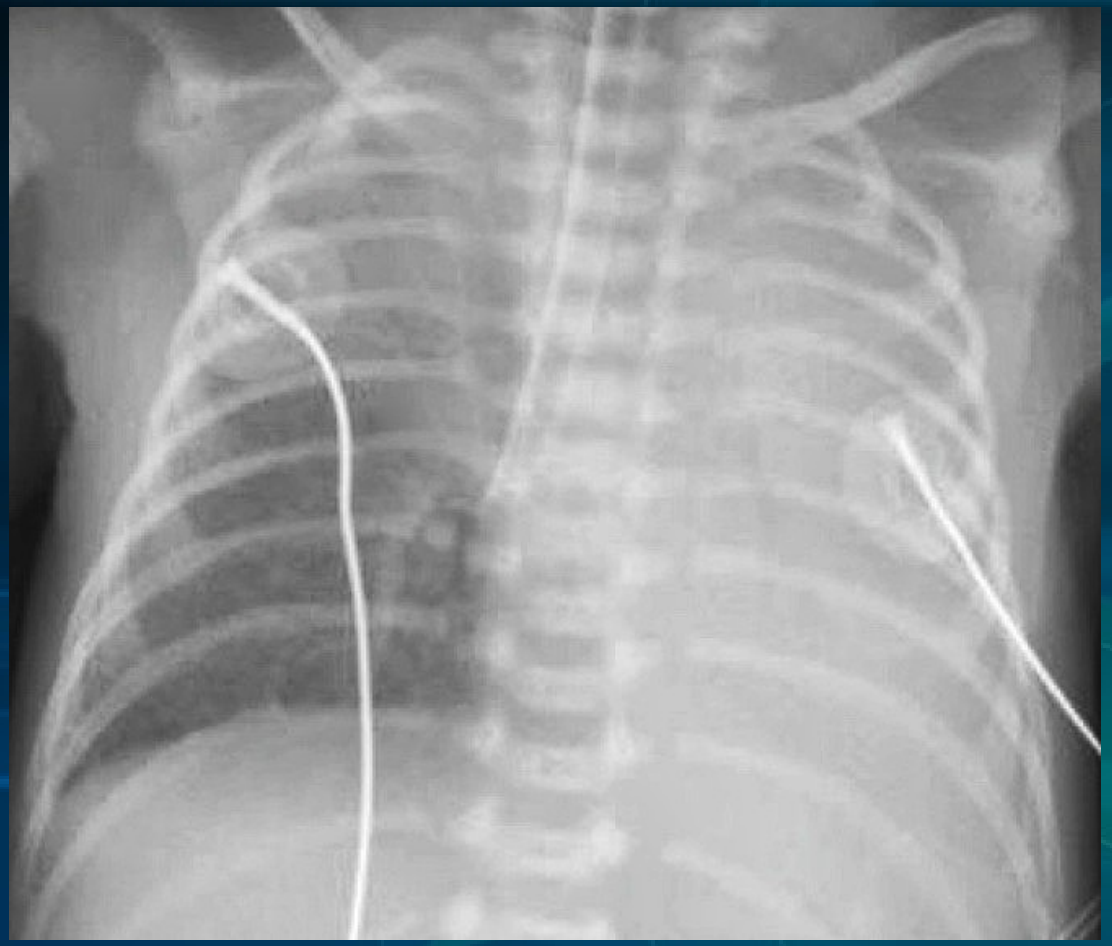
Atelectasis
Total right lung atelectasis, with rightward shift of the mediastinum



Chest Radiography: Atelectasis

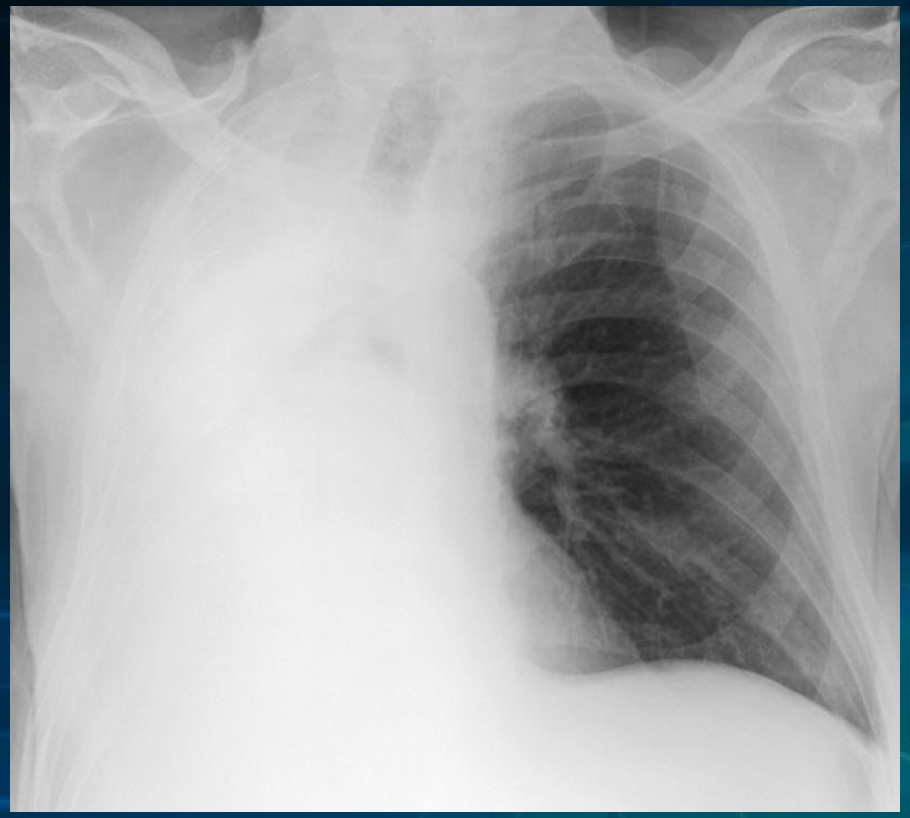


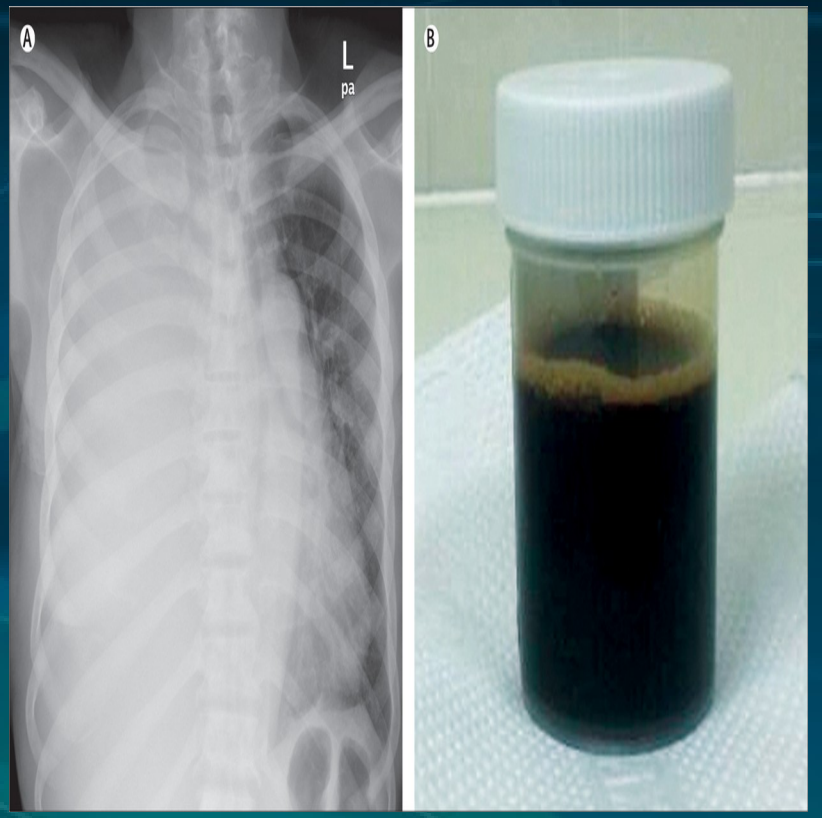
Chest Radiography: Atelectasis



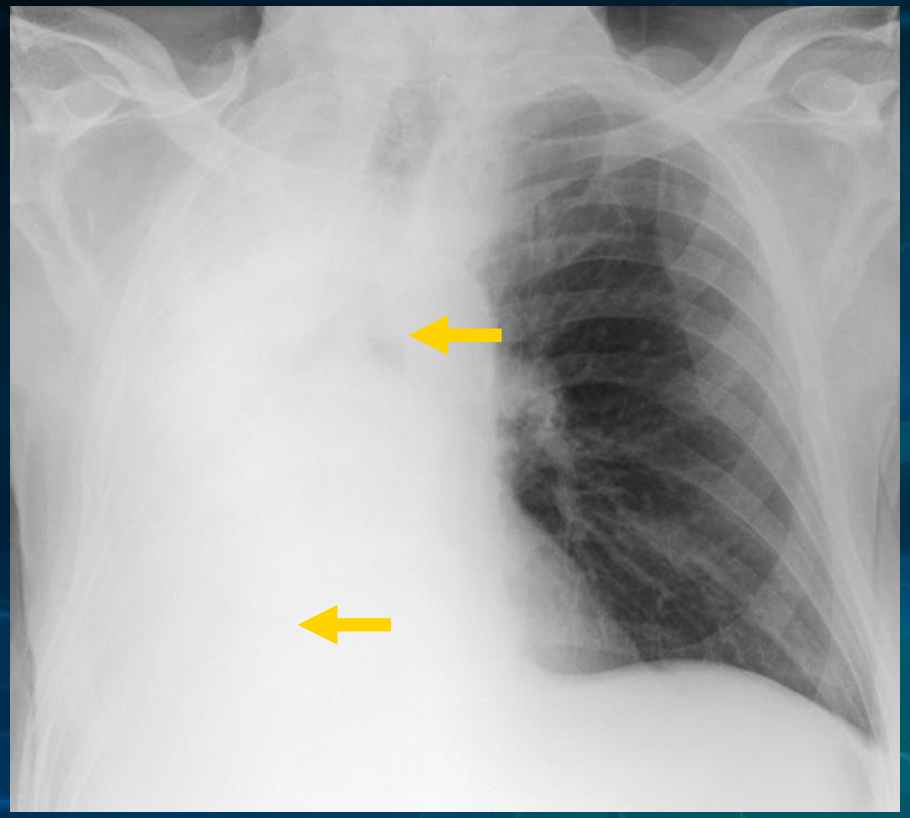
ET tube malposition causing occlusion of left mainstream bronchus, and total left lung atelectasis

Chest Radiography: Atelectasis vs Effusion



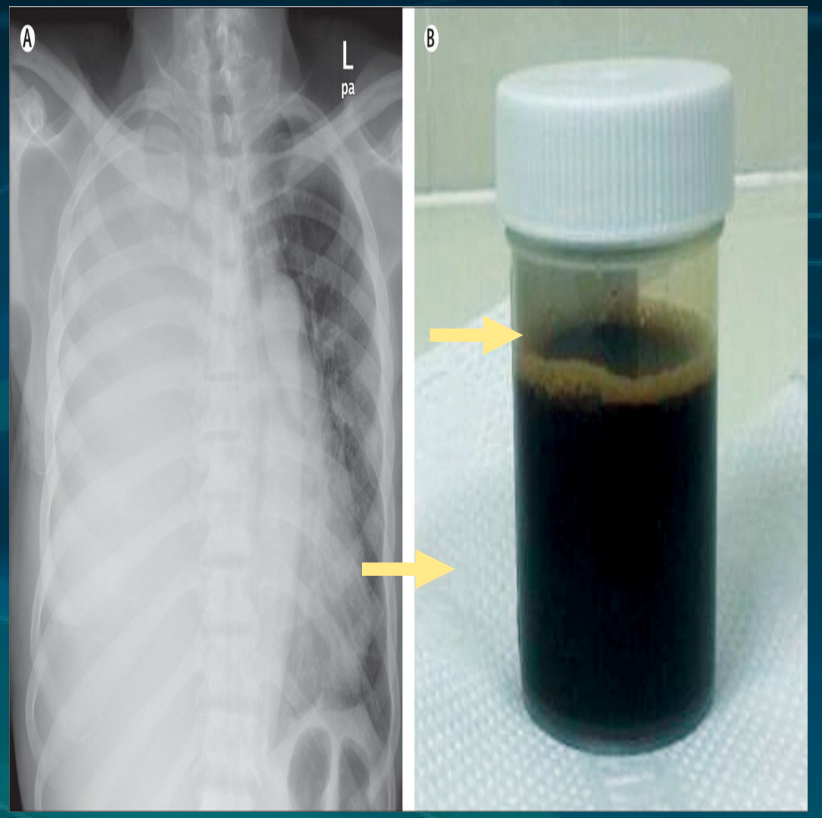


Chest Radiography: Atelectasis vs Effusion



Total lung atelectasis

With mediastinal shift towards opacity



Large pleural effusion

With mediastinal shift away from opacity

TABLE 1

Approximate Ionizing Radiation Exposure from Common Imaging

Imaging modality	Radiation dose (mSv)	Number of posteroanterior chest radiographs for equivalent exposure	Hours of commercial air travel for equivalent exposure
Plain radiography			
Chest (posteroanterior view)	0.02	1	6.7
Lumbar spine (three views)	1.5	75	500
Upper gastrointestinal series	6	300	2,000
Cardiac catheterization (diagnostic/stent)	7/15	350/750	2,300/5,000
Computed tomography			
Head	2	100	650
Cervical spine	3	150	1,000
Chest	7	350	2,300
Virtual colonoscopy	10	500	3,300
Abdomen/pelvis	14	700	4,650
Pulmonary embolism protocol	15	750	5,000
Cardiac angiography	16	800	5,300
Dual energy x-ray absorptiometry (with computed tomography)	0.04	2	13
Mammography	0.4	20	130
Nuclear stress test (thallium)	40.7	2,035	13,550
Nuclear stress test (sestamibi one-day)	9.4	470	3,100
Panoramic dental radiography	0.01	0.5	3.3

mSv = millisieverts.

Information from references 18 and 19.